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SCIENTIFIC AMERICAN

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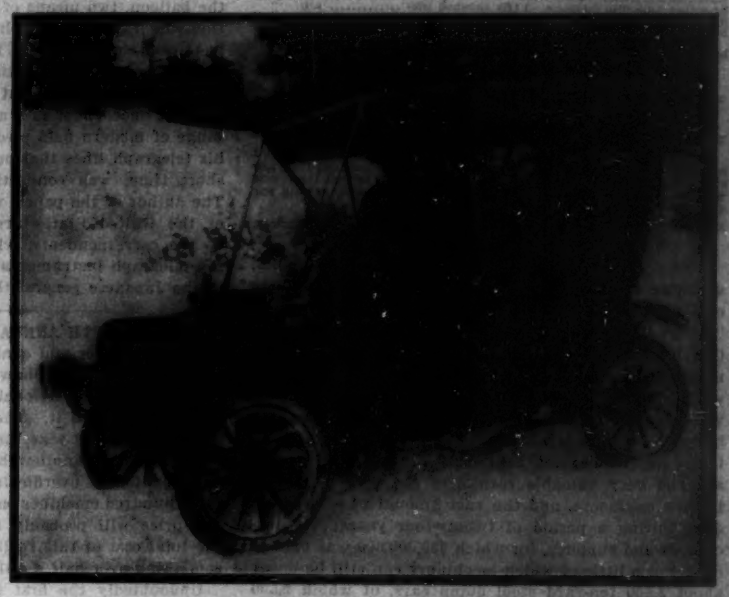
The New Reo 16-Horse-Power Side Entrance Tonneau.



The Rambler 20-Horse-Power Tonneau with Cape Cart Top.

The 30-Horse-Power Franklin Four-Cylinder Air-Cooled Car.

The 15-Horse-Power White Steam Touring Car.

A Maxwell 16-Horse-Power Double Opposed-Cylinder Touring Car Disputing the Right of Way with a Runabout of the Same Type in Central Park.

SOME LEADING 1905 CARS AS THEY APPEAR IN MID-WINTER.

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, JANUARY 28, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

OUR ASSETS AT PANAMA.

The present Chief Engineer of the Panama Canal, speaking recently of our acquisition of the holdings of the French company, gave it as his opinion that "the trade was certainly a good one"; and in proof of this he briefly enumerated some of the leading elements embraced in the transaction. In the first place, we are now in possession of a strip of land 10 miles wide and 47 miles long; we hold the franchise; we have 99 per cent of the stock of the Panama Railroad, including the Panama Steamship Line; all the elaborate and very valuable results of the surveys of the French engineers, and the vast amount of excavation done during a period of twenty-four years; the machinery and supplies, for which $29,000,000 was paid in cash, not a little of which machinery can still be used; about 2,500 ten-yard steel dump cars, of which 2,500 are serviceable; and between two and three hundred locomotives, which, according to the Chief Engineer, are "a great deal better than the average locomotive that an ordinary railroad contractor uses." Furthermore, Mr. Wallace says that we have steel enough for 150 to 200 miles of construction track, and considerable heavy excavating machinery, which has been kept under cover, and is in very good condition. The "trade" was certainly an exceedingly good one.

ASPHALT FLOORING AT SUBWAY STATIONS.

Mere considerations of decency, to say nothing of health, should prompt the subway officials to lay down a concrete or asphalt surface above the roadbed at the subway stations. At present, the broken stone ballast is made the recipient of cigarette and cigar stumps, being in fact nothing more than a magnified cuspidor, with all the unfragrant surroundings associated with that receptacle. The subway officials, of course, will claim that if a certain section of the traveling public would practise good manners, the broken-stone ballast would be kept just as clean as any other; but unfortunately the nuisance is still in our midst, and we have to accept the situation and make provision to meet it. There is no objection whatever to the use of stone ballast between the stations, where there is no opportunity for the accumulation of refuse; but the stretch of track extending the full length of the platforms and a few yards beyond should certainly be covered with a smooth layer of asphalt or cement, with proper connection to the drains, so that the whole could be regularly flushed with water. The Board of Health has already made this recommendation, and it is backed by the hearty indorsement of every decently-minded resident of this city.

HISTORY REPEATS ITSELF.

The proposal that the city should erect a moving stairway at Thirty-fourth Street and Broadway, to accommodate the crowd of foot passengers at this dangerous crossing, is not so altogether original a proposition as the sponsors of the scheme might suppose. As far back as the year 1867, a similar congestion prompted the erection of a bridge across the intersection of Broadway and Fulton Street. The bridge was illustrated at the time in this journal. That, however, was long before the day of escalators and moving sidewalks, and those who wished to dodge the risks of crossing Broadway at grade, had to pay the penalty of a climb over a steep stairway. Hence the Fulton Street passenger bridge was foredoomed to failure. The practicability of the moving stairway has been proved by several years of successful work, and we can see no reason why the proposed Thirty-fourth Street bridge should not be a thorough success, especially if it were built of the width and with the running speed that would be demanded by the impatient foot passenger traffic at this point. There are other congested and dangerous crossings in the city where the system might be applied to good effect. Of course, a subway would be preferable to an overhead structure; but subway space must be left inviolate for the possible needs of our rapid-transit extensions. Furthermore, by carrying the structure, whose weight would not be a serious problem, upon a pair of light arched trusses, it could be rendered architecturally pleasing.

WARFARE BY TELEGRAPH.

In the course of a paper read by Gen. Greely recently before the Military Service Institution, the speaker paid high tribute to the skill with which the Japanese have made use of the field telegraph and the balloon, two means of communication and observation which they have applied with a success that hitherhas been unsurpassed in warfare. The General brought out the interesting point that in the recent great flanking movement at Liaoyang, Gen. Kuroki was not once under fire, and this in spite of the great range of modern field pieces. So perfect, indeed, were his telegraph lines that only once, and that for a very short time, was connection with headquarters lost. The author of the paper, who is the chief signal officer of the United States army, quoted approvingly one of the correspondents, who said that the clicking of the telegraph instruments at headquarters meant more to the Japanese general than the sound of the guns.

THE FIFTH ANNUAL AUTOMOBILE SHOW.

In the number and quality of its exhibits, the Fifth Annual Automobile Show at Madison Square Garden, New York, is unquestionably a great advance upon any that has preceded it. The applications for space were so numerous this year that the foreign machines were obliged to seek another home. Nevertheless, the Garden is filled to overflowing, there being no less than three hundred machines on exhibition; and as the average price will probably range from $1,600 to $1,700, the total cost of this really wonderful display must be something over half a million dollars.

Undoubtedly the first impression left by a general survey of the exhibit is that the industry has settled down to the production of a certain limited number of standard types. In this respect the present show is in marked contrast to those of four or five years ago, when a large proportion of the work done by our manufacturers was experimental, and was prompted by the desire to strike out on original lines, and get away from the designs which had already become standard among the foreign builders. Although the best American machines of to-day conform broadly in design and workmanship to the European models, our builders have left their stamp upon the industry in more than one direction; notably in the production of light touring cars and runabouts, driven either by steam or by air-cooled gasoline motors.

It is gratifying to notice the general refinement of design and workmanship that characterizes the whole of the exhibits. There are some machines shown that are undoubtedly equal to the best of the French and German cars. Moreover, the industry has now assumed such proportions that the steel makers find it worth their while to manufacture special grades of steel, on specifications furnished by the automobile builders. This has resulted in a great improvement in the reliability of frames, crankshafts, and transmission gears, and all parts that are subject to the extremely severe stresses peculiar to the automobile.

Perhaps it is safe to say that the greatest improvement has taken place in the engine, the advance being in the direction of reliability and ease of operation. For the larger cars, the four-cylinder engine is used almost exclusively. The experience of the past year has shown that the use of four cylinders does not, as was feared, complicate the engine, nor introduce any added difficulty of operation. The parts can be made lighter, and the distribution of the stresses on four cranks has shown to good effect in reducing the number of broken shafts. At the same time, the opposed two-cylinder horizontal engine seems to hold its own in the American machines of moderate size and power. Another characteristic development is the air-cooled motor, which has been found to give such excellent satisfaction that it is being made in units of considerable horse-power. A beautifully designed and finished three-cylinder compound engine of American manufacture was exhibited, which has two high-pressure cylinders placed on either side of a low-pressure cylinder, the high-pressure cranks being placed at 180 degrees to the low-pressure crank. The maker claims that the exhaust has been thereby reduced from a pressure of 60 to 80 pounds to the low figure, for a gas engine, of 10 pounds. Several ingenious improvements are shown in the control of the automobile, and particularly of the engine. Attention is being given to the control of the mixture rather than of the spark, the means of manipulation being so arranged on the steering wheel that the driver can change the speed of the car without having recourse to the transmission-gear lever. The automatic float-feed carbureter seems to be preferred, and mechanically-operated valves are universal. Practically all of the American cars use the jump-spark ignition. A few make use of the magneto, although this device is not so common on American as it is on foreign machines. Water-cooled cylinders, honeycomb radiators, in which the draft is assisted by a fan, and forced circulation of the water, is the most usual combination on the larger cars, as is also forced lubrication from a pump which, together with the water pump, is driven from a countershaft geared to the crankshaft. Mention should be made of an ingenious arrangement shown on one engine, in which the exhaust valves are placed in domes above the cylinders, and the valves and cylinders are cooled by means of a down draft of air from a blower.

In this year's exhibition tubular framing is conspicuous by its absence, and the pressed-steel frame has taken full possession of the field in all except some of the smaller cars. The advantage of the pressed-steel frame is that it lends itself to the irregular shapes and sections that are demanded by the peculiar strains to which the automobile frame is subjected. There is a tendency to a more extended use of ball bearings, and some excellent designs with a new system of separators are exhibited. The bevel drive has almost exclusive control of the field except in some of the heavier and higher-powered machines, and some of the lighter cars, on which the chain drive is still shown. The sliding transmission gear, inclosed in a dust-proof aluminium case, is also coming into more extensive use, and the excellence of the material and the careful gear cutting have enabled the manufacturer to make this part of the machine thoroughly reliable. The bicycle wheel has disappeared with the bicycle tubing in automobile construction. Wheels are now generally of the artillery type and, because of their strength, form one of the most reliable elements in the machine. There is nothing strikingly new in tires, unless it be a new non-skidding type referred to last week, in which the tire proper is covered with a leather sheet vulcanized on, carrying on its tread another thickness of leather, which is thoroughly armored with studs or plates of hard steel. These tires have given excellent results, both in protection to the inner rubber tire, and as a preventive of skidding on wet asphalt or greasy roads. Mention should also be made of an improved tire, in which parallel threads, imbedded in rubber, take the place of the usual woven fabric. Each thread is thus practically incased in a rubber sheath, which serves to protect it from moisture and abrasion, and prevents the flow of air along the fabric, should the tire be punctured and the air tube leak. There is also less tendency for the tire to heat as the result of internal friction of the fabric.

The improvement of the automobile that is most conspicuous to the eye is in the bodies, which are, many of them, really magnificent specimens of the coach builder's art. This result is explained largely by the fact that the automobile business has reached a stage at which the coach builders have found it worth while to devote their time to the design and construction of convenient and handsome car bodies. Generally speaking, there is a reaction from the over-elaborate curves of some of the earlier machines, and a disposition to make use of straighter lines and simpler forms. The cylindrical and semi-cylindrical design of bonnet, which is becoming popular, has also added greatly to the appearance of the cars. The obvious advantage of providing protection from the weather is bringing in a general adoption of canopy and Limousine tops. Some of the closed carriages are beautiful and luxurious specimens of carriage upholstery.

In the important matter of price, it is evident that the great reduction which many people expected to take place when the trade had grown to its present proportions is not to take place, at least for the present. As a rule, the purchasers who can afford to buy an automobile of any kind, big or little, realize that in the present state of the art, a lower price would mean the incorporation of cheaper materials and less careful workmanship, which is the very last thing an intelligent purchaser desires.

After a long search over the wilds of Dartmoor, a monolith—12 feet long, 4 feet wide, 2 feet 6 inches in thickness, and weighing six tons—which has defied the effacing fingers of time and tempest, has been found to stand at the head of Sir H. M. Stanley's grave at Pirbright. Lady Stanley desired to obtain a stone "fashioned by the ages, tempered and colored by time, and untouched by man." Such a stone was discovered on a farm, lying recumbent on the borders of a natural roadway. Three of its faces had been exposed for uncounted generations. The difficulties of its removal from Devonshire were considerable, but they were eventually overcome, and it now stands in the quiet village churchyard, a fitting tribute to the memory of the great explorer. The inscription bears not only the name so familiar to Englishmen, but the words "Bula Matari" ("the Rock-Breaker") indicate the title he bore in Darkest Africa.

THE HEAVENS IN FEBRUARY.

BY GARRETT P. SERVISS.

The general aspect of the starry heavens in February is not widely different from that which they presented in January. The constellations, all moving together, like an endless panorama, have simply shifted their positions thirty degrees, or two hours of right ascension, toward the west. This change of place is sufficient to cause the stars that in January were near the western horizon to disappear beneath it, and to bring into view above the eastern horizon other stars, not visible a month earlier. But the central and more conspicuous part of the sky shows little change except that Orion now stands on the west instead of the east side of the meridian, while the brilliant Sirius, at 9 o'clock in the evening at the middle of the month, appears almost exactly on the meridian, and some thirty-odd degrees above the southern horizon.

In the SCIENTIFIC AMERICAN for December 31 last, the constellation Orion was described with sufficient detail to enable anyone not previously familiar with the stars to recognize it, and to use it as a center of reference in finding other constellations. It will serve the same purpose in February, but it may be interesting and helpful to the beginner to point out the fact that the Milky Way may now be used as a line of reference for many of the most brilliant stars and constellations. The Milky Way is, however, too delicate a phenomenon to be well observed except on a perfectly clear and moonless night. It is also hopelessly dimmed by the glare of near-by electric lights. But seen in a country neighborhood, it is a marvel of beauty. At this season it rises like an arch (very irregular in outline, and varying greatly in brightness at different points) in the north-northwest, passes through the zenith, and disappears in the southeast. Its brightest parts are those overhead and toward the north.

Along the western border of the Milky Way, beginning in the south and ending in the northwest, the observer will see, in the order named, Canis Major with the flaming Sirius, Orion, Taurus with Aldebaran and the Pleiades, Perseus with Aries almost directly south of it, and Andromeda, the lowermost of whose long row of stars marks a corner of the Square of Pegasus, now sinking below the horizon. Along the eastern border of the Milky Way, following the same direction as before, he will see, opposite to Canis Major, an almost blank region occupied by Monoceros, then Canis Minor with the brilliant Procyon, then Gemini with its pair Castor and Pollux, then Auriga, whose chief star Capella is within the edge of the Milky Way, then Camelopardalis very inconspicuous, and finally Cassiopeia, whose zigzag of bright stars is entirely enveloped in the galactic glow.

Over in the northeast, opposite to Cassiopeia, as if balancing with her on a seesaw having the pole-star for its point of support, appears Ursa Major or the Great Dipper. East of Gemini is Cancer, recognizable by the glimmer of the little star cluster called Præsepe, or the Manger, and east of that again, having risen into a more prominent place since January, appears the sickle-shaped figure of Leo, whose brightest star is Regulus. Below Cancer is seen the diamond-shaped head of Hydra, a very long but not brilliant constellation which stretches away and disappears under the eastern horizon. Its single ornament is Alphard, a lone second-magnitude star below Regulus.

THE PLANETS.

Very splendid in the evening sky appear Jupiter and Venus. As in January, it is better to choose an earlier hour for observing them than that selected for studying the constellations, because they are both in Pisces, which is close to the western horizon and consequently sets early. Seven o'clock is not too early to begin observations. At the beginning of February the two great planets are between 20 deg. and 25 deg. apart, Jupiter being farther east and north than Venus. By the middle of the month they will be less than 15 deg. apart, and at the end of the month less than 5 deg., Venus in the meantime having moved northward as well as eastward. Although in actual magnitude Venus is very much smaller than Jupiter, she appears the brighter of the two because of her greater nearness to both the earth and the sun. The eye perceives at the first glance a notable difference in the color of the two planets, Jupiter's light having a pale golden tint while that of Venus is as white as if reflected from burnished silver. This difference arises from a variance between the nature of the reflection from the surfaces of these planets. The telescope shows that the disk of Jupiter is strikingly colored while that of Venus is virtually colorless.

Venus attains her greatest eastward elongation from the sun on the evening of February 14. At that time about one-half of her disk, as seen from the earth, appears illuminated; in other words a telescope will then show her in the form of a half-moon. After that date she will begin to assume a crescent shape, less than half of her disk appearing illuminated, yet she will continue to increase in brightness for more than a month, because she will still be approaching the earth, and the effect of this approach will more than counterbalance that of the decreasing ratio of her illuminated disk.

Mars is still far over in the east, in the constellation Libra near the borders of Virgo, and cannot be well seen before two or three o'clock in the morning. He is slowly growing brighter, but his reign will not come until May and June, when he will be very bright.

Saturn is in conjunction with the sun on the 12th, passing after that date into the morning sky, but remaining for a long time too near the sun to be observed.

Mercury is a morning star in the constellation Sagittarius at the beginning of the month, and may be seen before sunrise. He is, however, approaching the sun. Mercury and Saturn are in conjunction on the 24th.

THE MOON.

New moon occurs on the morning of the 4th; first quarter near noon on the 12th; full moon on the afternoon of the 19th; and last quarter on the morning of the 26th. The moon is in apogee on the 8th, and in perigee on the 20th.

The lunar planetary conjunctions occur as follows: Mercury on the 2d; Saturn on the 4th; Venus on the 8th; Jupiter on the 10th; Neptune on the 15th; Mars on the 24th; Uranus on the 28th. There is a partial eclipse of the moon on the 19th, invisible in America.

JUPITER'S NEW SATELLITE.

The news from the Lick observatory of the discovery of a sixth satellite of Jupiter by Perrine, with the Crossley reflector, recalls in a striking way the recent discovery by Pickering of the ninth satellite of Saturn. Both are very minute bodies and comparatively distant from the planets that they attend. The new Saturnian satellite, however, is far more distant than that of Jupiter. It is probable that all of the larger planets are attended by minute satellites which escape telescopic scrutiny, but some of which may be detected from time to time with improved photographic apparatus.

AN ELECTRIC-ACOUSTIC SEA-SOUNDING APPARATUS.

A Norwegian engineer, H. Berggraf, has recently invented a new apparatus for sea sounding in which it is not necessary to touch bottom. This is accomplished by an acoustic method. The depths are also registered graphically upon a revolving drum. The operation of the device depends upon the time which sound takes to travel to the bottom and return, and the measurement of the time thus gives the depth to which the exploring apparatus is lowered. According to experiments it is found that sound takes 1 second to make the double distance of 2,000 feet. In his recent trials the vessel was equipped with an acoustic tube which could be lowered into the water. By means of an ordinary clock he could take the depth with considerable precision; thus four seconds shows about 8,000 feet. For more exact work he uses a registering apparatus, in which the depth is indicated on a band of paper. The apparatus consists of three parts—a transmitter, an acoustic receiver, and a chronometer. The sound is formed at intervals by a revolving disk which turns slowly and carries a projection on the periphery. The latter is made to strike against a fixed point and thus makes an electric contact at each revolution. The electric circuit has a magnet which operates a vibrating armature, and each time the contact is made, a sound is sent toward the bottom of the sea, whence it comes back to the vessel and is received in a microphone. The microphone is specially constructed so that it is only sensitive to sounds for which it is tuned, by means of a resonator. The vibrator is tuned to the same pitch, so that the membrane, upon receiving the sound from the bottom, will vibrate, and this movement is registered in the apparatus, taking account of the time which has elapsed between the closing of the electric contact and the reception of the sound in the microphone. It is said that the apparatus gives a very good set of curves for the different depths of sea bottom.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1517, opens with an instructive article by Emile Guarini on an interesting producer-gas plant. Dr. N. Caro writes a valuable article on incandescent lighting by means of acetylene and the carburization of acetylene. The fifth installment of Prof. N. Monroe Hopkins's splendid series on experimental electro-chemistry likewise makes its appearance. In this paper the velocity of electrolytic induction is discussed, experiments with a high-speed special chronograph, capable of dividing a second into a million parts, being described. Prof. William Bateson concludes his splendid treatise on Breeding and Heredity. A new type of rotary pump is described which is reversible, and yet gives a true piston stroke like an ordinary pump. The British correspondent of the SCIENTIFIC AMERICAN describes a twelve-cylinder 150-horse-power racing motor for auto boats. Prof. E. C. Pickering writes on the light of the stars. Prof. G. W. Ritchey's paper on the Modern Reflecting Telescope and the Making and Testing of Optical Mirrors is concluded. In this installment he describes how a great reflecting telescope is mounted.

SCIENCE NOTES.

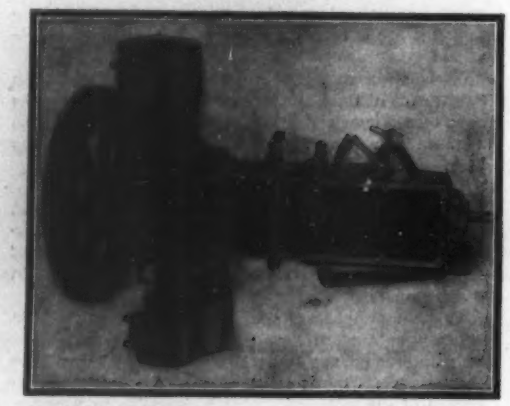
In the October number of the Astrophysical Journal, Herr A. Nippoldt, of the Potsdam Magnetic Observatory, criticised a recent paper by Father Cortie on "The Solar Prominences and Terrestrial Magnetism." The latter had endeavored to show that the eclipse spot group of 1901, if it may be so called, by far the largest spot group of the year, had no effect upon terrestrial magnetism. Herr Nippoldt claims that a small but evident disturbance did take place during the passage of the spot. He is also emphatic that we have no right to assume that no disturbance has taken place unless magnetic stations near the pole have exhibited no deviations from their normal curve. He insists that there should be no kind of statistical definition of the idea of disturbance, that the maximum amplitude can hardly be usable to decide whether or not a curve is disturbed, and that we may represent the nature of the effect of the solar action upon terrestrial magnetism as a sort of relay action—"the strength of the releasing solar activity need not have a definite relation to the strength of the magnetic storm." He therefore desires to substitute for the statistical method the investigation in detail.

Berlin, says Knowledge, possesses a successor to the late lamented chimpanzee Consul, in the shape of Consul II., of which the following account has been published: Recently Consul II. appeared before a meeting of the German Psychological Society, and was the subject of a lecture by the eminent psychologist, Prof. Hirschlaff. The ape stood on the platform beside the lecturer in a smoking jacket, top hat, black trousers, boots, and shirt. Prof. Hirschlaff gave Consul an excellent character. He has good manners, is of a friendly disposition, and manifests symptoms of what would be called in human beings a loving nature. He has no objection to the vicinity of dogs, cats, or snakes, but is afraid of horses. No traces are seen in Consul of any special liking for women and soldiers. Like most apes he delights in children, but evinces an abhorrence of dolls, of which he can make nothing, and retires vanquished from their presence. If Consul is tickled he sometimes shrieks with laughter. When punished he acts like a child, holding his hands before his face. If discovered at anything he is forbidden to do he assumes hypocritically an innocent demeanor, which is distinctly human. He is restless, and cannot sit long in one position. With an excellent memory, he is yet incapable of expressing his wants either by gestures or sounds. He cannot be taught to whistle, nor does he understand human speech. All he can comprehend is the tone of a voice or the rhythm of words; and he cannot be taught to reckon. Although Prof. Hirschlaff said that the psychological abilities of Consul are separated from those of human beings by a wide gulf, it is interesting to note how many complicated actions he can comprehend with the intellectual powers he possesses.

The description (in the Annals and Magazine of Natural History) of a new species of those strange worm-like burrowing amphibians generally known as coecilians, but which may be better designated in popular zoology as snake-salamanders, would scarcely seem at first a subject for notice in this column; but, as a matter of fact, this particular case has a very wide and important interest. The species in question, which comes from Kacher district of Assam, is described by Major Alcock under the name of *Herpele fulleri;* and it is in regard to the peculiar geographical distribution of the genus that the interest of the new discovery lies. With the addition of the new species, the genus *Herpele* is represented in India, Panama, and West Africa; and, as Major Alcock remarks, such a distribution in the case of a worm-like burrowing group appears altogether inexplicable on the theory that continents and ocean-basins are permanent, or, indeed, anything like permanent. On the other hand, the distribution of *Herpele,* together with that of certain sublittoral hermit-crabs, which is curiously similar, affords strong support to the now generally accepted view that India and Africa were connected by land at a comparatively recent epoch of the earth's history (that is to say, within the lifetime of an existing highly specialized genus). The two instances also add one more link to the chain of zoological evidence which apparently points to a former land connection between Africa and South America across the Atlantic. The Indo-African connection, which is supported by geological as well as by zoological evidence, would explain the presence of coecilians in the Seychelles as well as the absence of the above-mentioned littoral hermit-crabs from the east coast of Africa. The alternative view to the trans-Atlantic connection between West Africa and America (apart from one by way of the Pacific) would be that these snake-salamanders traveled from a common northern home down the Eastern and Western Hemispheres, but this seems almost incredible.

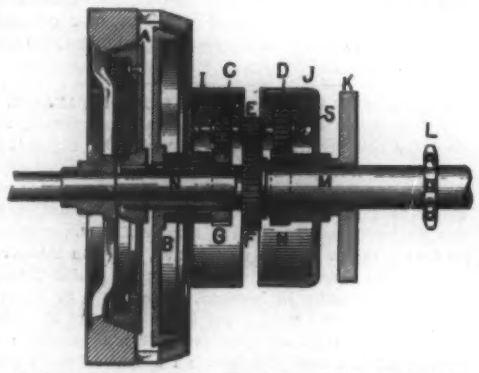
SOME LEADING AUTOMOBILES OF THE PRESENT YEAR.

The 1905 Rambler touring car is practically the same as the 1904 car of this name, which was one of the most popular on the market last year. The principal change has been in the body, which is now a side-entrance tonneau of the prevalent style, as can be seen from the photograph on our front page. The Rambler automobile is built by Thomas H. Jeffery & Co., who have one of the most complete factories in America. Practically every part of the machine is built in the immense plant at Kenosha, Wis. The engine used in this car is a 5 x 6 double opposed-cylinder motor capable of developing 18 horse-power at 1,000 R. P. M. The pistons are each fitted with six rings in pairs. The engine is mounted longitudinally on the chassis under the forward seat, and has a two-speed-and-reverse planetary gear transmission of novel construction, the gears of which do not revolve when the engine is running idle. A diagram of this transmission, which is of the usual type now employed having no internal gears, is shown herewith. Two cone clutches, *A* and *B*, are used in the flywheel. *A* locks the sprocket sleeve, *M*, to the motor and gives the direct, or high-speed, drive, while *B* contacts against a ring bolted to the flywheel. *B* has a sleeve extending to the right over *M*, and carrying on its end gear, *G*, which meshes with pinion, *C*, fastened on a revolvable stud, *S*, mounted in the two gear drums, *I J*. This stud has another pinion, *D*, near its other end. A smaller-sized pinion, *E*, between the two meshes with gear, *F*, on the sprocket sleeve, while *D* meshes with gear *H* on the sleeve of drum, *J*, which revolves on the sleeve of the brake drum, *K*, solid with the sprocket sleeve, *M*. If clutch, *B*, is let in, and drum, *I*, is held stationary by a brake band, *G* drives the pinion, *C*, in the reverse direction, and *E* drives *F* (and hence the sprocket, *L*) in the same direction as that in which the engine is rotating, but at a reduced speed. This is the low speed. The reverse is obtained by holding drum, *J*, which causes gear, *D*, when rotated as before by *G C*, to revolve with a planetary motion around gear, *H*. This planetary movement also tends to be produced by *E* acting upon *F*; but as the latter is only held from revolving by the weight of the machine, while *H* is positively held by a brake band, and as *E*, being smaller, must make more revolutions in traveling around *F* than does *D* in traveling around *H*, *F* must revolve slowly in the reverse direction in order that *E* shall make the requisite number of revolutions to circle around *F* once while its adjoining pinion, *D*, is circling once around the stationary drum gear, *H*. The consequence is that the sprocket is revolved slowly in the reverse direction. If no provision were made for unclutching the main driving gear, *G*, from the engine when the car is at rest—this gear is in all ordinary transmissions solid on the crankshaft—as soon as the band brake on *J* was released, this drum and its gear, *H*, would revolve slowly, and *F* and *L* would remain stationary. By throwing out clutch, *B*, this condition does not obtain, and the engine can be run idle without the gears turning. The transmission is heavily constructed, with large bearing surfaces for the various sleeves. The planetary pinions of bronze are six in number, there being two studs. There are also two auxiliary pinions separated by a coiled spring and so arranged as to stop backlash and chattering of the gears. The gears are packed in grease. The two speeds ahead and one reverse are had through large cone clutches in



The Maxwell 16-Horse-Power Motor and Sliding Gear Transmission with Multiple Disk Clutch.

the flywheel, upon which the wear is slight and which do not readily get out of order. The low and high speeds are obtained with a single long lever outside the body, the reverse being had by a pedal. The application of the transmission brake throws out the high-speed clutch. The car is provided with emergency



Rambler Planetary Transmission With Flywheel Clutches.

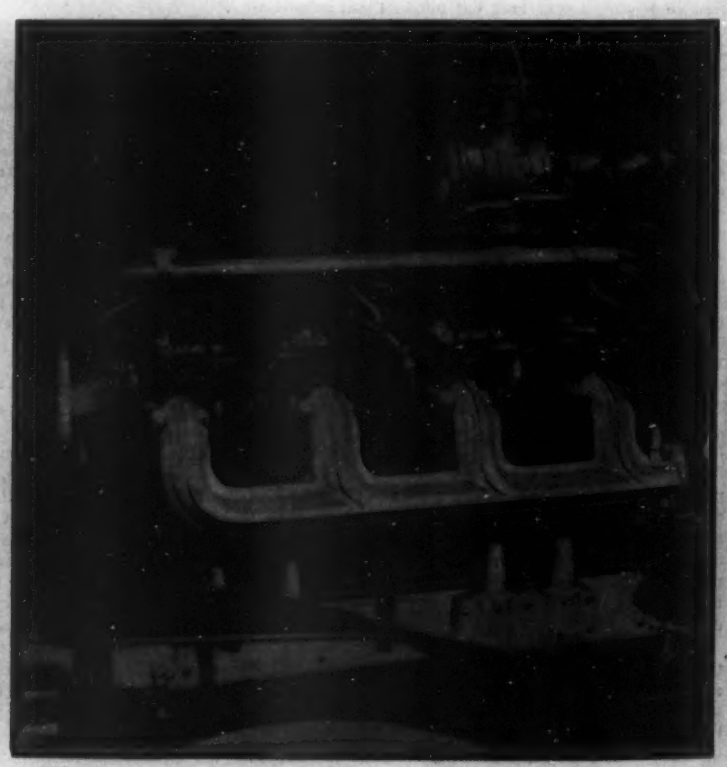
hub brakes. Roller bearings are used throughout. The steering post can be tilted forward by the driver when entering the car. The throttle is connected to a wheel immediately below the steering wheel, and is operated by grasping this wheel with the fingers and tilting it upward. The spark is timed automatically by a centrifugal governor on the two-to-one cam shaft. The frame of the Rambler is of pressed steel in the shape of the letter U. A tube across the top of the U, which is at the rear of the car, completes the frame. The fuel and water tanks are in front under the bonnet. A readily detachable wood body, finished in olive green, conceals almost entirely the mechanism of the car.

The air-cooled Franklin touring car, shown on our front page, is one of the largest and most powerful cars of this type that has ever been constructed. The engine is rated at 30 horse-power at 750 R. P. M., while at 1,000 R. P. M. it will develop nearly 10 horse-power more. Although the car has a 110-inch wheel base, it weighs complete only 2,400 pounds. It will thus be seen that it has ample power for the weight, all of which goes to make it a speedy car. The motor is a 5 x 5 flanged cylinder engine, with both exhaust and inlet valves in the heads of the cylinders, and with an auxiliary exhaust port at their base, so that when the piston uncovers this port, a great part of the exhaust gas blows out through a check valve before the piston exhausts the remainder upon its upward stroke. This special feature, together with a good-sized belt-driven fan at the front of the motor, keeps this motor sufficiently cool to operate in any ordinary temperature. All the valves and their seats may be readily removed by unscrewing two nuts on each valve cap. The engine is oiled by splash lubrication, the oil being maintained at a constant level in the crank case by a special oiler which feeds by gravity. A single automatic float-feed carbureter supplies all four cylinders with gas. The engine is connected to a three-speed sliding gear transmission fitted with roller bearings throughout and having gears of nickel steel. A universally-jointed propeller shaft extends to the rear axle, which is of the live type, mounted on roller bearings and revolved by bevel gears. The bevel gears are held in absolute alignment, and the bevel pinion shaft is supported at each end by bearings. The frame of the Franklin car is of wood, which, it is claimed, is more resilient, and transfers less of the shocks of the road to the car mechanism. The bonnet of the car can be tilted forward for examination of the motor, or it can also be quickly removed if desired. The body is of aluminium, and is finished in the very best style. It is claimed that a speed of fifty miles an hour can be maintained with this car over good roads. As the H. H. Franklin Manufacturing Company was the first to build a practical four-cylinder air-cooled touring car, so it is now the first to bring out a large and powerful car of this type capable of maintaining a high speed.

The cut on this page shows the new air-cooled motor, brought out by the Corbin Motor Vehicle Corporation, of New Britain, Conn., and originally exhibited at the Automobile Show in this city. The cylinders have grooves cut in them, and small pieces of thin sheet steel are set in and tightly peened, thus making a cylinder having a considerable radiating surface. On the larger car large fans, arranged over the cylinders, are

(*Continued on page 83.*)

19-Horse-Power Franklin Air-Cooled Motor Fitted with Auxiliary Exhaust Pipes, Which Cause a 20 Per Cent Increase in Power.



16-Horse-Power Corbin Air-Cooled Motor Having Steel Strips Set in the Cylinder Walls for the Purpose of Radiating the Heat.

IMPROVED FOUR-CYLINDER AIR-COOLED MOTORS.

A TYPICAL AMERICAN FOUR-CYLINDER GASOLINE TOURING CAR MOTOR.

The motor shown in the annexed cut was one of the finest exhibited at the Automobile Show recently, where it was seen mounted on a large touring car, the product of the H. H. Buffum Company, of Abington, Mass. It is composed of four individual integrally-cast cylinders fitted with mechanically-operated inlet and exhaust valves, both make-and-break and jump-spark igniters, and a special automatic carbureter with hydraulic governor. The motor flywheel, seen at the left, has gear teeth cut in its periphery for the purpose of driving positively a gear water pump, which forces water at a varying pressure, according to the speed of the engine, against a horizontal diaphragm seen beside the motor in the center of the picture. This diaphragm operates a piston valve on the carbureter below, as well as a small auxiliary air valve, which is opened as the speed increases. The piston valve can be set, by a lever on the steering wheel, to close only to the point that gives the desired speed. The low-tension magneto ignition is supplemented by that of the high-tension type with batteries and coils with vibrators; the motor can be readily started by the latter system by switching on the current, and afterward run by the former system of ignition. The commutator for the primary jump-spark current is placed horizontally at the front end of the motor, the four small wires running to it from

(Continued on page 84.)

THE BUFFUM 30-HORSE-POWER MOTOR FITTED WITH MAKE-AND-BREAK AND JUMP SPARK IGNITION, MAGNETO, AND HYDRAULIC GOVERNOR.

Winton Motor as Viewed From the Front.

This photograph shows the air-pump, *A*, connected by the pipe, *a*, to the diaphragm, *H*, and the four chambers above the inlet valves containing the air pistons. *O* is the gear-driven oiler; *P* the centrifugal water pump; *C*, the carbureter; and *M* the magneto with its distributor, *D*. The secondary wires run from *D* through *T* and fiber-lined bushings, *F*, to the spark plugs. *I I* are the inlet pipes to the two pairs of cylinders.

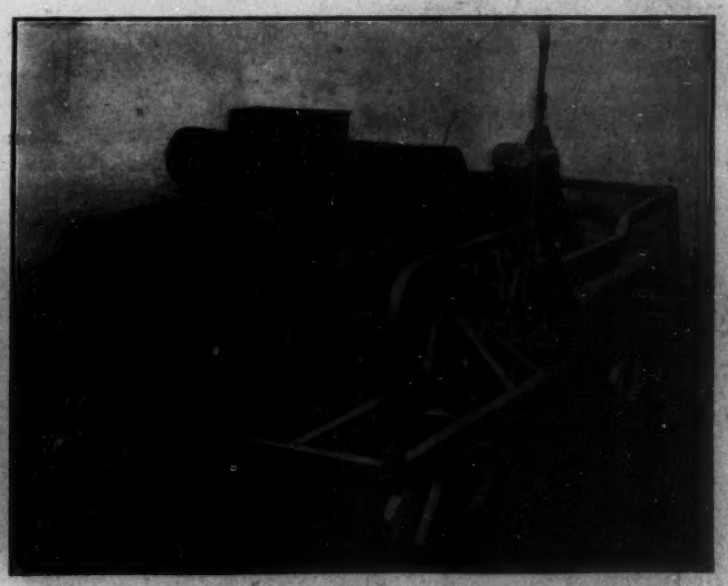
Winton Motor as Viewed From the Rear.

In this picture one side of the crank case has been removed and the end cylinder cross-sectioned, showing the piston with hollow wrist-pin and convex head; the exhaust valve, *e*; inlet valve, *i*, with air piston, *p*, on its stem; spark plug *S*; and primer handle and gasoline shut-off valve, *V* and *W*. Note the fan blades cast in the flywheel to aid in inducing a draught.

THE NEW FOUR-CYLINDER MOTOR USED ON THE WINTON CARS.

Motor Sleigh Viewed From the Front.

A 4-horse-power high-speed motor, mounted in front under a bonnet, furnishes the propelling power. There are two speed reductions from motor to crankshaft that operates pushers, *P*, by means of connecting rods, *R*.



Motor Sleigh Viewed From the Rear.

The sleigh is propelled by three pushers, *P*, operated by cranks, *C*, and connecting rods, *R*. The pushers are raised on the return stroke by specially-shaped cams, *K*.

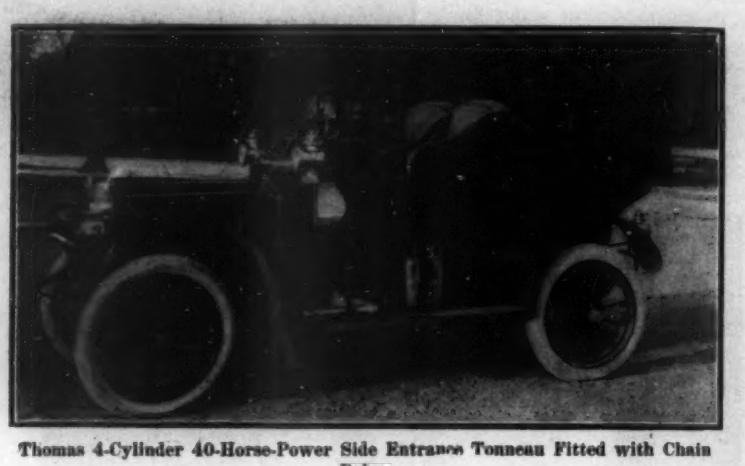
A NOVEL FORM OF MOTOR SLEIGH.

TYPICAL AMERICAN TOURING CARS FOR 1905.

The new side-entrance tonneau shown at the top of this page is the latest product of the Autocar Company, of Ardmore, Pa. The new car is comparatively light, its weight being but 1,900 pounds, while the 3½ x 4-inch four-cylinder motor used is capable of developing 16 to 20 horse-power. The Ardmore Company is another of the leading firms to this year bring out a four-cylinder vertical car. The motor cylinders are cast in pairs, with inlet valves on one side of the heads, and the exhaust valves on the other side. All valves are mechanically operated and interchangeable. The bearings of the crankshaft are bolted to the upper half of the crank case, so that the lower half can be removed without interfering with the bearings. Splash and continuous force-feed lubrication, by means of a gear-driven oil pump, is used for motor and transmission. The transmission is of the sliding-gear type, giving three speeds ahead and a reverse, with direct drive on the high speed. The shafts of the transmission run on large Hyatt roller bearings. A bevel-gear drive to the rear axle is employed. The rear axle and front wheels are also mounted on Hyatt roller bearings. The driving shaft within the rear axle is squared into the hubs of the wheels, thus avoiding the use of keys at that point. A bevel differential is used, and the large top cover of the differential can be removed, so that the gears may be inspected or adjusted at this point. The car is fitted with a band hub brake on each rear wheel and a band brake on the transmission. A pedal controls the former, while the latter is operated by a side lever, which is used as an emergency brake. If this brake is applied, the clutch is thrown out at the same time. The clutch is of the expanding ring type within the fly-wheel. It is ordinarily operated by a pedal, and this pedal may be set to hold the clutch out, if desired. The steering apparatus consists of a bevel gear and segment, and a novel feature of this car is two grips, one on either side of the steering wheel, by twisting which the spark and throttle are operated. The contact box is brought up back of the dashboard and directly in front of the driver, so that should the occasion require it, this box can be got at as easily as can the vibrators on the spark coil, which is also mounted on the dash. As will be seen from the plan of the chassis, this car is simple in construction and a typical example of the four-cylinder vertical motor as applied with a three-speed transmission and bevel-gear drive.

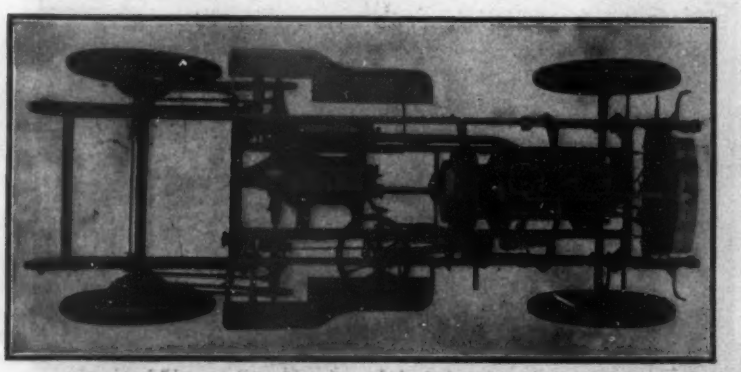
The 1905 Thomas touring car is built on the same

New 20-Horse-Power Autocar Tonneau Fitted with 4-Cylinder Vertical Engine and Bevel Gear Drive.



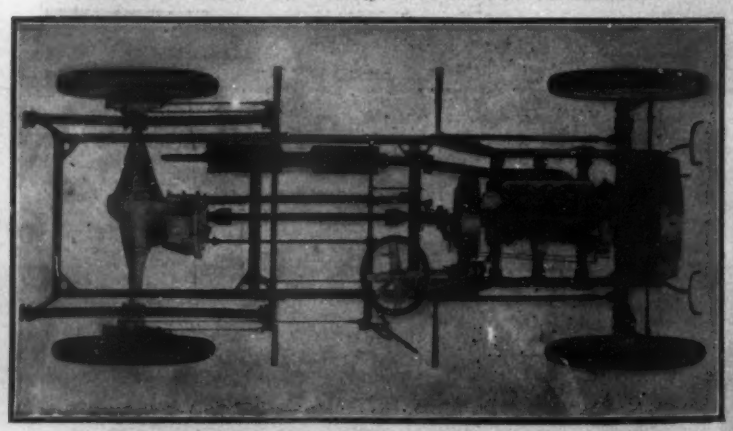
Thomas 4-Cylinder 40-Horse-Power Side Entrance Tonneau Fitted with Chain Drive.

Chassis of Autocar, Showing Bevel Gear Drive.



Chassis of Thomas Car, Showing Chain Drive from Countershaft.

The Packard 28-Horse-Power Side Entrance Tonneau.



Chassis of Packard Car, Showing Transmission at the Rear Axle.

The Stevens-Duryea 20-Horse-Power Side Entrance Tonneau Fitted with 4-Cylinder Vertical Engine.

The Winton 24-Horse-Power Side Entrance Tonneau with 4-Cylinder Vertical Engine.

NEW AMERICAN TOURING CARS.

general lines of construction as the last year's car, which was described in our previous Automobile Number. The Thomas company has abandoned the three-cylinder motor for one of the four-cylinder type, developing 40 or 50 horse-power, and it also makes a six-cylinder, 60-horse-power racer and touring car. Mr. E. R. Thomas has given great attention this year to perfecting the body of his automobile, and the new body, while having very graceful lines, has also an abundance of space for storing articles needed in touring. In a locker located in the tonneau behind the forward seats, there is sufficient room to place two suit cases, or this space can be filled with drawers, shelves, or small lockers. There are 4,388 cubic inches of locker space in this one compartment, while by lifting the two cushions of the tonneau seat a space 36 inches long by 10 inches wide by 12 inches deep, or a total of 4,752 cubic inches, is exposed. Under the tonneau floor is a space 33½ inches long by 31½ inches wide by 3½ inches deep, or 3,693 cubic inches. This space is capable of accommodating a 32 x 4-inch tire, extra inner tubes, repair kit, and tools. Beneath this tire box is another compartment 21½ x 12½ x 4⅝ inches (2,205 cubic inches), which has sufficient room to carry a long pump, oiler, large tools, waste, etc. These two lockers are opened by a door at the back of the machine. There are also two small lockers, one on either side of the dash, besides pockets 14 inches long by 2 deep in the upholstered sides of the tonneau doors. It will thus be seen that every provision has been made for the accommodation of the tourist. The total storage space provided is 15,858 cubic inches, or more than 9 cubic feet, and this space is all obtained without in any way encroaching upon that necessary for the comfort of the passenger. The dashboard is made of rolled steel and is curved over sufficiently to protect the spark coil and to allow a space for the two small lockers mentioned above. A single coil with vibrator is used for all four cylinders, and the commutator is arranged beside the coil. The five sight-feed oilers are mounted on the dash on the other side of the coil, and the dash is provided with a brass pan at its bottom to catch any oil drippings. The motors are built with automatic inlet valves. The transmission used on the Thomas cars gives three speeds with direct drive on the high speed and with the gears on the lay shaft remaining idle. It is impossible to shift the gears before first throwing out the clutch by means of the pedal, and should the pedal be released while changing gears, the clutch cannot engage until the gears are entirely in mesh. The transmission gears and inside bearings all run in an oil bath, and the outside bearings are lubricated with chain oilers. Another good feature of the Thomas car is the safety ratchet device in the rear wheels, which makes it impossible for a car to descend a hill backward should the chain break. Either the 40 or 50 horse-power car will, it is claimed, develop a speed of 60 miles an hour, and yet they may be throttled to about four miles an hour on the high-speed gear. A foot throttle is used, and this can be instantly set or released by the foot. It is automatically closed when either brake is applied, thus preventing the motor from racing. The spark advance lever is directly under the steering wheel. One of these cars received a road test of 5,000 miles during the past fall and early winter.

The Peerless 60-Horse-Power Side Entrance Tonneau Fitted with Bevel Gear Drive.

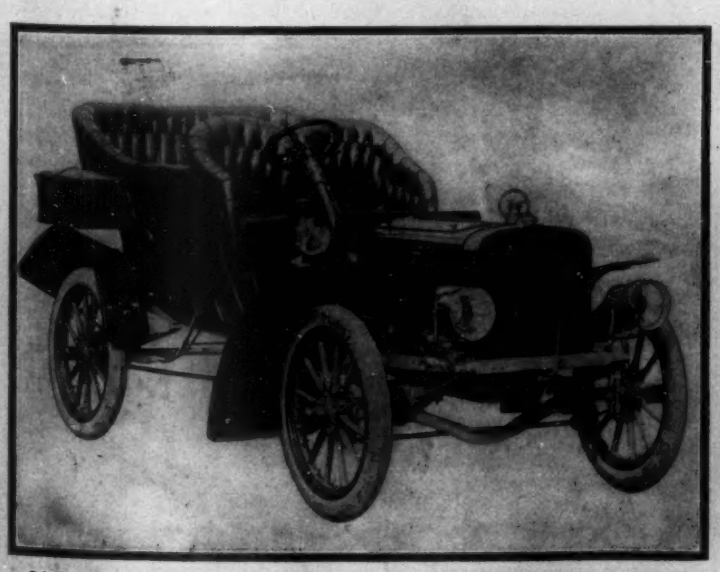
The illustrations show the chassis and complete car manufactured by the Packard Motor Car Company, of Detroit, Mich. The machine differs from that built last year principally in the dimensions of the cylinders of the motor, which are now 4 1-16 x 5⅛ bore and stroke, and in the proportioning of the essential parts to stand the additional power.

An inspection of the Packard factory will convince anyone that this car is one of the finest and most thoroughly well-built American machines; great care is used throughout its manufacture, and every part is finished in the most thorough manner. The new side-entrance tonneau weighs 2,200 pounds, and has an engine with separate integrally-cast cylinders capable of developing 28 horse-power, and fitted with mechanical valves and gear-driven oil pump. But one sight-feed is used, and this is sufficient to supply oil to the crank case and keep the oil level at the proper height, so that all the working parts are well lubricated by splash. The contact box is arranged on top of a vertical shaft projecting up from the crank case in front of the dash-board and driven by helical gears. An automatic carbureter supplies a practically uniform mixture at all speeds of the motor. The radiator is of the finned tubular framed-in type, the water being circulated by a positively-driven gear pump. The motor is provided with a governor, which automatically controls the speed at whatever point the throttle is set for. A range of from 6 to 50 miles per hour is obtainable on the high speed. By means of the accelerator pedal, the power may instantly be increased to any desired extent. The main clutch is an expanding band working in an auxiliary drum within the flywheel of the motor. This clutch is readily adjustable for wear, and also has a certain amount of self-adjustment. The main feature of the Packard car is the live rear axle, which has combined with it a transmission gear of the sliding type, giving three speeds ahead and one reverse. The rear axle, as well as the transmission gear, is fitted with ball bearings throughout. The balls are of large size, and sufficiently numerous to bear any strains that are liable to be put upon them. A long driving shaft with universal joints extends from the motor back to the transmission on the rear axle. The frame is of cold-rolled steel, pressed so as to form a girder truss, the corner supports and cross members being riveted through steel gusset plates. The standard Packard suspension, consisting of semi-elliptical springs in the rear and a transverse spring at the front end for supporting the frame in the center, is used. The brakes are of the duplex double-acting type, and are both on the rear wheels.

The regular foot brake consists of bands on the outside of the brake drums attached to the rear wheels, and an emergency brake consists of expanding rings on the inner surface of these same drums. The regular foot brake is not interlocking with the clutch, but on applying the emergency brake, the clutch is automatically released. The placing of the brakes on the rear wheels takes all strain off the transmission and rear axles. The wheel base and tread of the new machine are 106 and 56½ inches respectively. Aluminium is used in the paneling of the body and for the mud guards and bonnet. The car is extremely roomy, and is finished off in dark blue, which is very effective.

The J. Stevens Arms and Tool Company have this year brought out a new model in their four-cylinder touring car, having a vertical motor in front, connected to the usual sliding gear, and with transmission by bevel gear at the rear axle. The car, as shown in our illustration, is a roomy side-entrance tonneau, capable of seating five persons comfortably. It has a wheel base of 90 inches, the standard track of 56 inches, and is mounted on 30-inch wood artillery wheels. The weight of the car complete is but 1,650 pounds, while the motor is a 20-horse-power one, having individual, integrally-cast cylinders. The exhaust and inlet valves are in a common chamber on one side of each cylinder, and are both mechanically op-

(Continued on page 85.)



24-Horse-Power Ford Tonneau Having Copper Water Jackets, Bevel Gear Drive and Two-Speed Planetary Transmission.

The 35 to 40-Horse-Power Columbia Royal Victoria Side Entrance Tonneau Having a Chain Drive to the Rear Wheels.

NEW AMERICAN TOURING CARS.

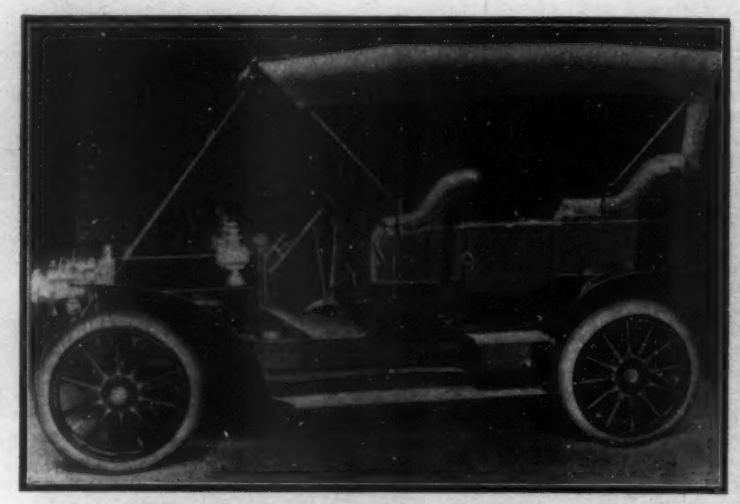
FOREIGN AUTOMOBILES AT THE IMPORTERS' SALON.

The illustrations below on this page show some of the finest foreign cars that were exhibited on the top floor of the Macy building in this city during the past two weeks.

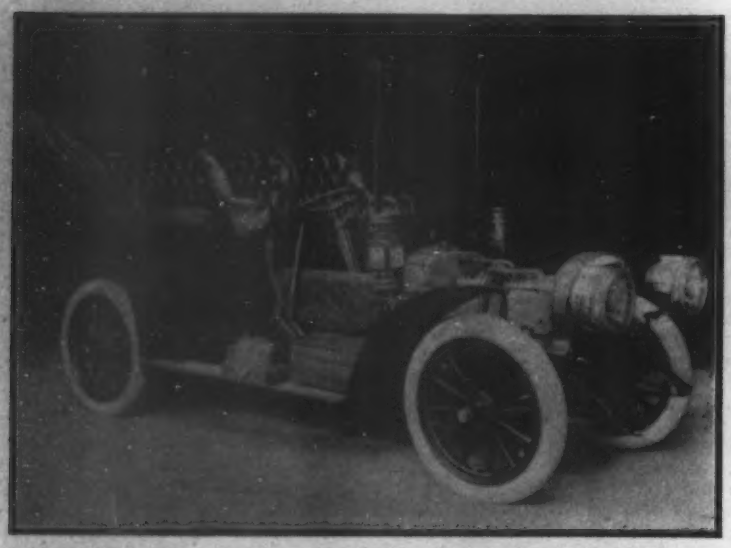
The large Hotchkiss closed car at the top of this page was one of the handsomest automobiles of this type exhibited. It is intended for both city and country use, and is both luxurious and commodious. It is fitted with a 20 to 24-horse-power motor having its crankshaft mounted on ball bearings like those shown in the cut (page 61), and which is fitted with mechanically-operated inlet valves, low-tension magneto ignition, a mechanical lubricator, and a honeycomb radiator having triangular tubes so arranged that the entire surface of every tube is utilized for cooling the water, which is circulated by a centrifugal pump gear-driven from the cam shaft. The make-and-break igniters are of a special construction, which causes a quick break even at slow speeds. Two levers in the steering wheel control the spark and throttle. When the clutch is thrown out, the carbureter is automatically throttled, so that the engine does not race. The clutch and brake pedals are of the push type, on long vertical levers. The universally-jointed driving shaft is so arranged as to permit of longitudinal as well as angular displacement, thus removing from it all strains except torsional ones. The expanding-ring brakes on the rear wheels are compensated in an ingenious way, so that one cannot act more strongly than the other. The experience of the Hotchkiss firm with a ball-bearing crankshaft during the past year shows that if properly constructed and with the best materials such a bearing is practical. The winning of several races on land and water is credited to this feature. Non-adjustable ball bearings are used throughout the car wherever possible. The springs separating the balls can be compressed, and the balls assembled in the lower half of the ring, which is then dropped and the balls removed, when it is desired to take the bearing apart. Tubes of oil-soaked felt are inside each spring.

The Martini automobile is made in Switzerland by the well-known gun firm of that name. It is built under the Rochet-Schneider patents, and it has made several fine performances both in England and on the Continent. The car which we illustrate is the 18 to 20-horse-power model, containing a four-cylinder motor, three-speed transmission gear, and chain drive to the rear wheels. The cylinders of the motor are 100 millimeters (3.937 inches) bore, and the pistons have a 130 millimeter (5.118 inches) stroke. The motor speed can be varied from 200 to 1,200 R. P. M. All the valves are mechanically operated and interchangeable. The carbureter is fitted with automatic air and gas regulator, and is heated from the exhaust. The spraying nozzle is removable for cleansing without disturbing the float. Simms-Bosch magneto ignition of the low-tension type is used. The water is circulated by a gear-driven rotary pump, which is completely inclosed. A honeycomb radiator with a fan to aid in cooling the water is fitted to the front of the car. The bearings used throughout are of the

A Handsome Hotchkiss Limousine Fitted with a 24-Horse-Power Motor.



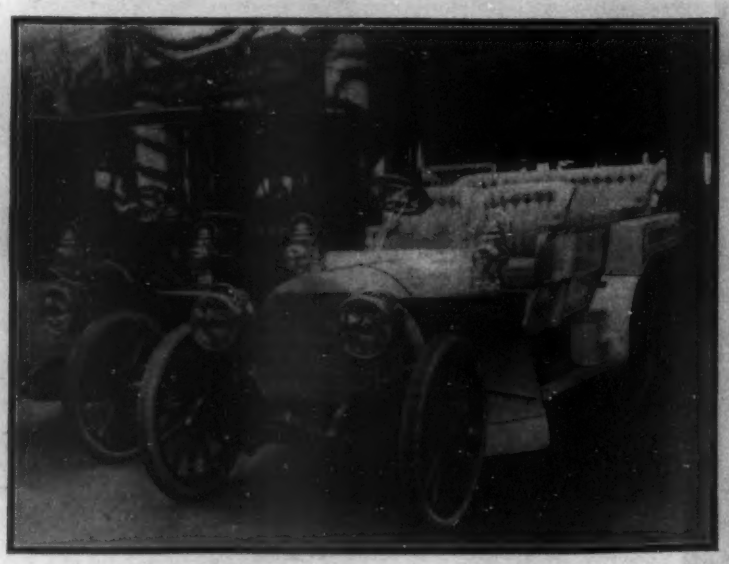
An 18 to 22-Horse-Power Swiss Martini Car Fitted with Cape Cart Top.



A 16 to 20-Horse-Power Delahaye Car. Leather Flaps Inclose the Front Entrance.

A 20 to 22-Horse-Power Darracq Covered Side Entrance Touring Car.

The Latest 23 to 32-Horse-Power German "Mercedes" Brougham.



The 24 to 30-Horse-Power Italian "Fiat" Side Entrance Tonneau.

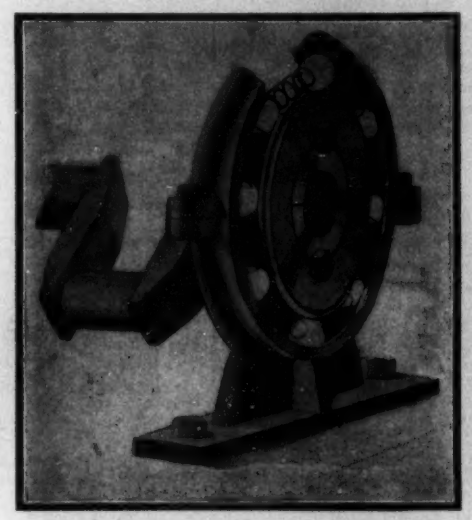
EXAMPLES OF EUROPEAN CARS EXHIBITED AT THE IMPORTERS' SALON.

latest non-adjustable type, illustrated in the cut on this page as applied to the crankshaft of the Hotchkiss motor. The artillery wood wheels are 34 inches in diameter, and are fitted with drums for double-acting expanding-ring brakes. The drums also contain ratchet teeth, into which a pawl is dropped when ascending a hill. Should the car stop from the breaking of a chain, and the brakes fail to hold, the ratchet would positively hold it. A double-acting metal band brake on a differential shaft is water-cooled from a small reservoir carried on the dash. Another feature of this car is a locking device on the differential shaft, whereby the differential can be locked and the car driven by one chain if found necessary. The starting crank is always held upright without the aid of straps. The gasoline is fed to the carbureter from the tank in the back of the car by means of air pressure, which is supplied from a positively-acting air pump. A gage is fitted to show the pressure. The cylinder oiler is heated by the exhaust, and arrangements are also made for pumping kerosene into the cylinders by a small hand pump connected with the kerosene reservoir. Among the achievements of this car are the ascent of the Rochers de Naye, one of the highest peaks of the Alps, on the ballast of the cogwheel railway roadbed (which was described in SUPPLEMENT No. 1460), and a 4,000-mile endurance run, lasting twenty-two days, which was completed in England about a month ago, and during the course of which a total consumption of 245½ gallons of gasoline was effected, and an average daily mileage of 181.8 miles was made. The water evaporated in traveling this distance was only 3.9 gallons, and the average mileage per gallon of fuel was 16.3.

The Delahaye machine, exhibited at the Importers' Salon, is fitted with a four-cylinder 16 to 20-horse-power motor, having low compression, and consequently being very smooth in operation. The cylinders are cast in pairs, and all the valves are mechanically operated. The ignition is of the jump-spark type by means of a high-tension magneto. A tubular radiator, cooled by a fan and having its water circulated by means of a centrifugal gear-driven pump, is used. The engine is oiled automatically by means of a mechanical lubricator. The carbureter employed is of the automatic type, and can be readily controlled from the seat. The car has a four-speed transmission, the speeds being obtained by a single lever, and the drive being direct on the high-speed. There are two double-acting metal band-brakes on the rear wheel, and one foot brake on the main shaft. A chain drive to each rear wheel is employed. The car has the standard tread and a variable wheel base of 90 to 130 inches, according to the wish of the purchaser. The chassis is of pressed steel, and has a width of 2 feet, 7½ inches. The car exhibited is finished in red, and fitted with red-leather side flaps on each side of the entrance to the front seat, for the purpose of inclosing the footboard of front seats, as well as the tonneau.

The covered side-entrance tonneau of the Darracq make, exhibited at the Importers' Salon by F. A. La Roche & Co., is one of the typical 1905 French cars. The motor used is fitted with high-tension ignition by means of a coil and batteries. The motor is also fitted with a governor, which acts on the throttle valve. A three-speed transmission operated by a single lever is used. This transmission gives a direct drive on the high speed. Some of the Darracq motors are fitted with low-tension magneto ignition, as well as that of the usual high-tension type. This firm is one of the few to build single and double cylinder cars, as well as those of the four-cylinder type. The Darracq cars hold many of the records abroad, among which is that for the flying kilometer in 21 2-5 seconds, equivalent to a speed of 104.46 miles an hour; and also the flying kilometer uphill at Gaillon, France, in 29 seconds, which is equal to a speed of 77 miles per hour. The non-stop run from New York to St. Louis and back—a total distance of 3,450 miles—which was made last summer by Mr. La Roche on one of these machines, should also be put down to the credit of the Darracq firm.

The 28 to 32-horse-power brougham shown herewith is one of the new Mercedes models for 1905. The engine has mechanically-operated valves, magneto ignition, and a special carbureter regulated by the governor and having an automatic auxiliary air valve. A fan-cooled radiator and the usual centrifugal pump are used for cooling the water. The car is fitted with four speeds and a reverse, and the brakes on the differential are water-cooled. There are expanding ring emergency brakes on the rear wheels. The steering gear is of the



The Ball Bearing Crankshaft on the Hotchkiss Car.

non-reversible type. The spark advance is fitted on the steering wheel. An automatic oiler worked by compression is used. The car is mounted on the usual frame of pressed steel, and is finished with the customary thoroughness of all German machines.

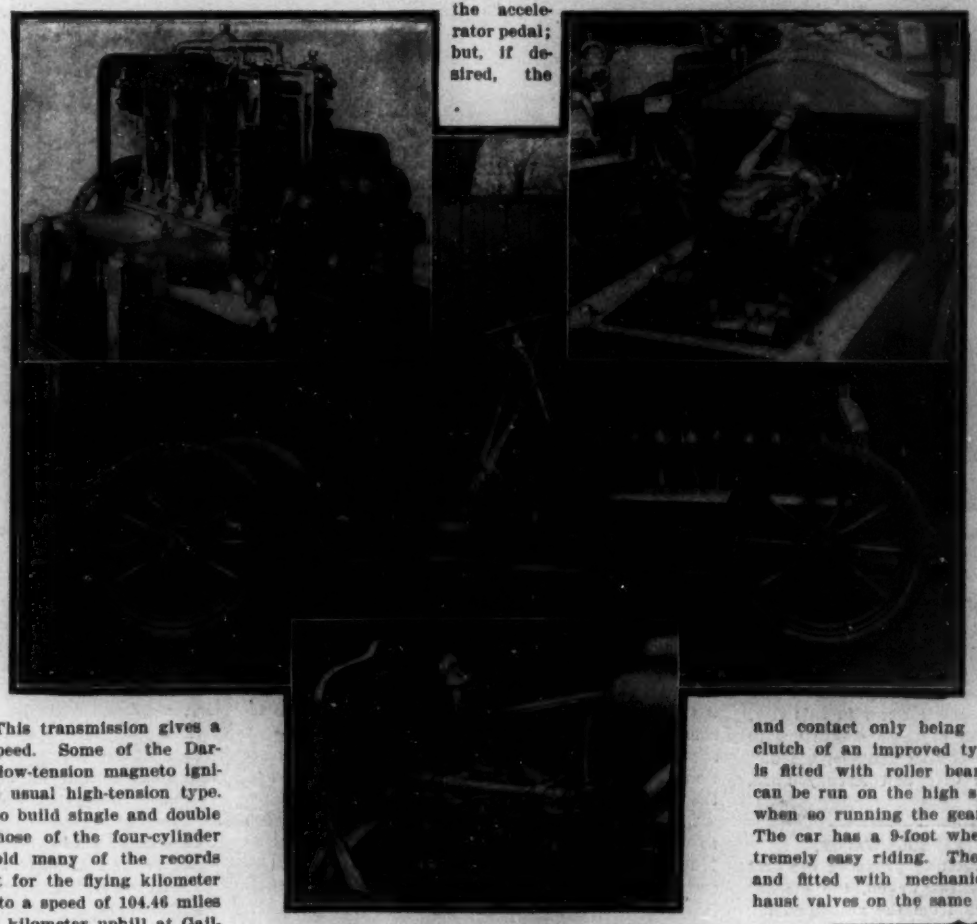
One of the main features about the Fiat automobile is its simplicity. The car is controlled by two levers and three pedals. The levers beside the seat change the gears and apply the brakes to the rear wheels, while the pedals let out the clutch, apply the differential brake, and operate the accelerator. The ignition is advanced and the throttle opened simultaneously in proportion to the speed of the engine. This is controlled by the accelerator pedal; but, if desired, the pedal can be interconnected with a small lever working over a sector on the steering wheel. The car shown in the illustration is of the 24 to 30-horse-power type, having a very large side-entrance tonneau. The engine is fitted with magneto ignition, and a mechanical lubricator supplies a definite quantity of oil to all cylinders regularly. The transmission gear gives four speeds forward and one reverse. The Fiat cars have been seen frequently on the race tracks of this country, and they hold several records for hill climbing, speed, and fuel consumption, both here and abroad.

The four-cylinder motor shown in the upper left-hand corner of the cut on this page is an excellent sectional model of the C. G. V. motor. This is one of the leading French automobile engines having make-and-break ignition by magneto, and mechanically-operated inlet valves on one side of the cylinders, the exhaust valves being placed on the opposite side. The large fiber gears which drive the half-speed cam shafts are visible in the cut, while the gear-driven magneto is also seen on the right of the motor. All the valves are readily removable and interchangeable. The bottom of the crank case may also be readily removed for inspection and adjustment of the bearings.

The right-hand upper picture shows the new Renault motor as arranged on the 14-horse-power car. The cylinders are cast in pairs, with the valves all on one side. All the valves are mechanically operated, and the ignition is by jump spark from a high-tension magneto located in front of the motor and driven by a spiral gear. The radiator is arranged in the dashboard. It is made up of finned radiating tubes running vertically and cooled by a blast of air from blades on the flywheel, which cause it to act as a fan. Large pipes convey the water from the top of the motor to the top of the radiator, and there is also a connection from the radiator to the bottom of the water jackets. No pump is used, the water being circulated on the thermo-siphon principle.

Another type of French motor employing magneto ignition, but of the low-tension make-and-break type, is shown at the bottom of the central cut. This is the 20-horse-power Richard-Brasier motor, which also has cylinders cast in pairs, with the exhaust valves on one side and the inlet valves on the other, all mechanically operated. The inlet-valve side of the motor is shown in the cut, the make-and-break igniters being visible at the four corners of the cylinders, besides two throttles between the pairs of cylinders, connected through levers to a common rod which passes to the governor. The rod on top of the motor carries the current to the insulated poles of the make-and-break igniters. This rod passes through fiber bushings and is covered with rubber. The large tubes from the top of the motor to the radiator, for conveying the water, are distinctly visible, as is also the vertical shaft with a universal joint and topped by bevel gears, which drive the mechanical oiler on the rear of the dash. The water is circulated in this machine also on the thermo-siphon principle.

The center picture shows the chassis of the new six-cylinder English Napier machine. This chassis was recently on exhibition in New York, and the car has been sent to Florida to compete in the Ormond races. The engine is fitted with high-tension ignition by magneto, a single coil and contact only being used. An all-metal friction clutch of an improved type is employed, and the car is fitted with roller bearings wherever possible. It can be run on the high speed about all the time, and when so running the gears on the lay shaft are idle. The car has a 9-foot wheel base, which makes it extremely easy riding. The cylinders are cast in pairs, and fitted with mechanically-operated inlet and exhaust valves on the same side of the cylinders.



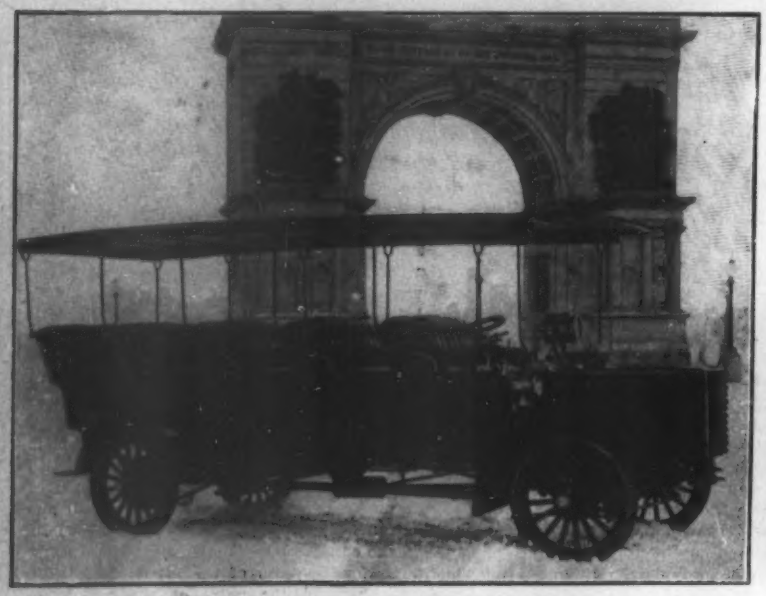
SOME FOREIGN MOTORS EXHIBITED AT THE NEW YORK SHOWS.

A beautifully cross-sectioned model of a four-cylinder C. G. V. motor is seen at the left; the new Renault motor and dashboard radiator at the right; a six-cylinder Napier chassis in the center; and the Richard-Brasier motor with make-and-break magneto ignition at the bottom.

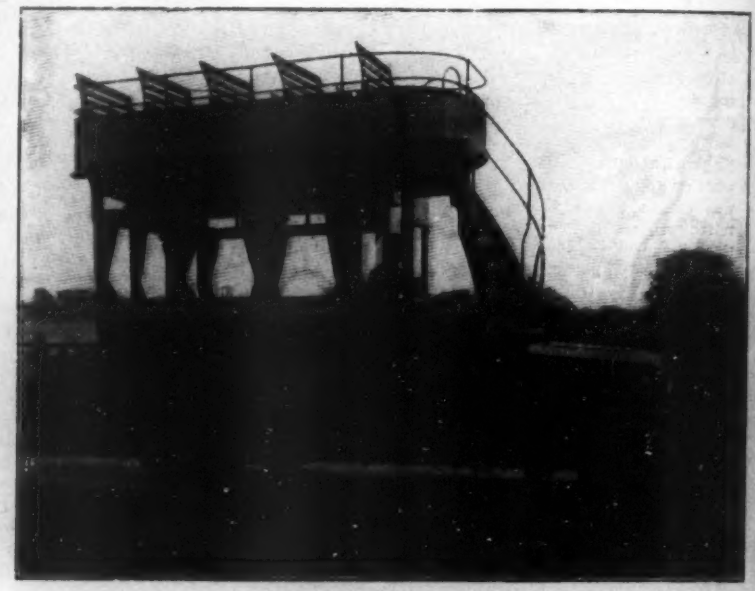
The greatest quantity of iron ore produced from one mine, in 1903, was 1,519,450 tons from the Fayal mine, on the Mesabi range in Minnesota. The greatest quantity from any southern mine was 1,231,409 tons from the Red Mountain group, in Alabama; from any eastern mine, 401,470 tons from the Cornwall group, in Pennsylvania.

TWENTY-PASSENGER AUTO-STAGE FOR LONG-DISTANCE ROUTES.

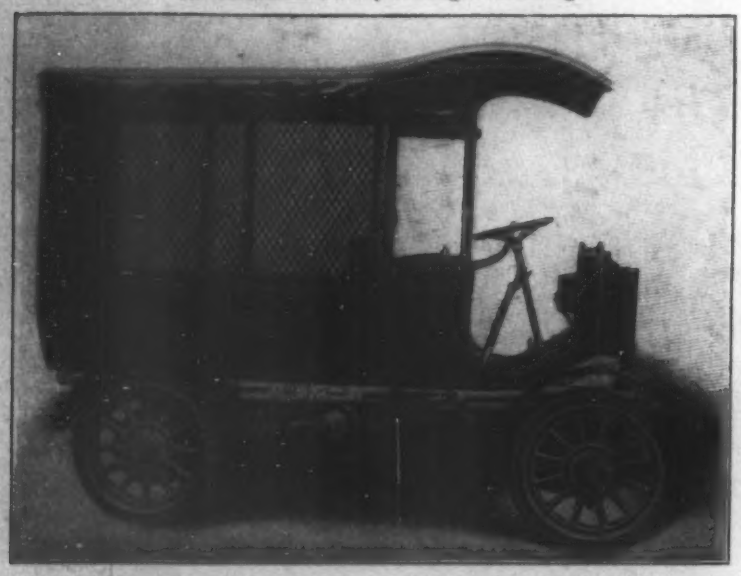
The large twenty-passenger stage shown in the annexed engraving is built by the Mack Brothers Company, of Brooklyn, N. Y. It is intended for carrying passengers long distances over roads, and on good roads a maximum speed of 25 miles an hour can be obtained. The car is driven by a four-cylinder 5½ by 6 gasoline engine, having mechanically-operated inlet and exhaust valves in single chambers at the side of each cylinder, and operated from a single cam shaft. Jump-spark ignition from a single vibrating coil is used. The current is supplied by dry batteries, and the secondary current is distributed to the various plugs by means of an Altemus distributor. A finned tube radiator of the usual type is employed, the water being circulated by a centrifugal chain-driven pump. A novel feature of this car is a compact device containing a powerful spring, which is wound up by the motor when it is running, and the energy of which is used to turn the engine over a number of times, in order to start it. This device does not interfere with the operation of the motor in any way, nor with its being started by hand, if found necessary. It can be fitted to any gasoline engine. The twenty-passenger stage shown was exhibited at the recent Automobile Show in this city, and we are told that several of these stages are to be used in a daily service between Philadelphia and Atlantic City, and Atlantic City and Asbury Park, during the coming summer.



The Manhattan Twenty-Passenger Auto-Stage.



An English Motor Omnibus.



Oldsmobile Delivery Wagon Fitted with 16-Horse-Power Vertical Motor.

Knox Patrol Wagon Propelled by 16-Horse-Power Horizontal Air-Cooled Motor.

SOME NEW TYPES OF COMMERCIAL VEHICLES.

A GASOLINE POLICE PATROL WAGON.

The Knox Company has recently produced the first American gasoline police patrol wagon, the general appearance of which is seen from the accompanying cut. The body is mounted on a standard double opposed-cylinder chassis. It is 5 feet 9 inches high inside, and under the usual seats running lengthwise on each side there is sufficient locker space to carry a stretcher, emergency kit, etc. The stretcher is fitted with four ball knobs, which drop into slots on the edges of the seats, so that it can be suspended, and does not need to be placed on the floor. This patrol wagon shown is being used by the Springfield, Mass., police department, and is giving entire satisfaction.

THE BRUSH MOTOR OMNIBUS.

The omnibus has been almost entirely superseded by the tram-car, but in sparsely-populated districts, where laying an expensive permanent way is not commercially practicable, there is a growing demand for motor omnibus services, by means of which passengers may be conveyed to the tramway terminals or the railway station.

The Brush Electrical Engineering Company, of Loughborough, England, has specially designed the vehicle illustrated for districts in which the traffic is small. The main feature of novelty is the transmission gear, which is of the individual clutch type.

With this type of transmission it is evident that when changing speeds, nothing but a simple movement of the lever is required; and as friction clutches are the means of transmission, there is no need to work the foot clutch when changing gear. Sudden shocks such as are experienced with other types of gears are entirely avoided, thus effecting a great saving in wear and tear, and a great reduction of vibration throughout the whole frame. The life of the tires is said to be also considerably extended owing to the increase of speed being gradual, thus preventing the ripping action due to wheels suddenly brought into mesh as in the ordinary gear.

The engine develops 30 horse-power at about 900 revolutions per minute. The bore of the cylinder is 110 millimeters (4.33 inches) and the stroke 130 millimeters (5.118 inches). The drive is by universally-jointed shafts to gear rings on the inside of the driving wheels.

The entrance to the omnibus and the method of paying fares when passing the driver, obviate the necessity of employing a conductor, and the saving in wages may be just sufficient to make the enterprise profitable. This type is therefore suitable as a feeder to railway and tramway systems, as it affords absolutely the cheapest form of passenger traction for thinly populated districts.

The advantages claimed for the system are the following: The change of speed is effected with the utmost simplicity, smoothness, and safety. There is no possibility of missing the striking of any gear desired, either in ascending or descending hills, as the gears are always in mesh. No jolting or jerking accompanies the increase or decrease of speed. Any omnibus driver can take charge of the vehicle after a few minutes' instruction, without any danger of his damaging the mechanism or losing control. If both brakes were to fail, the omnibus would be able to descend the steepest gradient at walking pace on its lowest speed. The reverse may be readily thrown in while the car is running forward on the second and top speed, which is specially advantageous in crowded streets.

THE NEW OLDSMOBILE DELIVERY WAGON.

Besides a new double opposed-cylinder side-entrance tonneau, the Olds Motor Works, of Detroit, Mich., have this year brought out the gasoline delivery wagon illustrated herewith. A type of motor new to the Olds Company is used on this car. This is a double-cylinder vertical engine situated under the driver's seat. This location of the motor makes it possible to use a longer body without increasing the length of the car, and, at the same time, the valves and other mechanism can be readily inspected or adjusted by removing the seat. The motor drives a countershaft, placed directly behind it, through a Morse silent chain; and the drive from the countershaft to the rear wheels is by side chains. The countershaft carries a planetary gear transmission containing bronze and steel gears running in oil, and giving two speeds ahead and a reverse. Expanding ring brakes are fitted on the hubs of the rear wheels, and there is also the usual band brake on the transmission. The former are controlled by a lever, and a pedal operates the latter. A tubular radiator is used with this car, the circulation being maintained by a positively driven gear pump. The motor is thoroughly

oiled by a mechanical lubricator. It has two vertical 5 x 5 cylinders, and is rated at 16 horse-power. Its crank-shaft is 2 inches in diameter and is a steel drop forging, as are also both axles of the car, which are of an I-beam section. The wheels are fitted with 4½ x 30-inch solid tires. The Olds Company also makes a lighter delivery wagon fitted with a single-cylinder motor of their well-known type. An automobile express company located in Detroit has used these cars for the past six months, and has obtained excellent results. One machine missed but one trip out of 198, and that owing to laying the machine off for some slight adjustments when it could have been run. The average cost of operation, including wages of the driver, was found to be 4.2 cents per mile, and the cost per package for delivery about 3 1-3 cents.

For the past three years, at Christmas time, the Olds Company has placed at the disposal of the postmaster of Detroit several of its delivery wagons for use in delivering and collecting mail matter and transferring it to the different sub-stations. During the holidays, recently, four delivery wagons were used. The postmaster informs us that "the service rendered by these machines was on the whole very satisfactory, and their use was instrumental in securing the delivery and collection of large quantities of mail matter in a very short period of time, and they were also of material assistance in the matter of making quick special trips to our station postoffices. It is, no doubt, a fact that the aforesaid congestion would have burdened the office for one or two extra days had not these machines been employed."

A GASOLINE TRUCK DRIVEN BY ALL FOUR WHEELS.

The Four Wheel Drive Wagon Company, of Milwaukee, Wis., has been experimenting for something over a year with a gasoline motor truck which drives by all four wheels. The illustrations shown herewith give a good idea of the appearance of the truck and its mechanism. It has been given tests in snow, through which it showed its ability to travel without the least hindrance, although the snow in places covered the axles and more than half of the wheels. It demonstrated the theory that a machine driving all four wheels independently will not slip its wheels, and will be able to travel through roads impossible to negotiate by a two-wheel drive, although its tires are neither corrugated, spiked, nor roped in any way, nor have they any special anti-slip device of any kind.

The machine shown will carry five tons. But while this machine is a chain-driven machine, the 1905 model, which is now being gotten out, will have a bevel gear drive throughout, the chain drive being superseded by this type of drive except for exceedingly heavy trucks.

The theory that the additional machinery necessary for driving four wheels as compared with driving two wheels would produce more extra friction, and consequent loss of power, than the value of any advantage which might be gained by a four-wheel drive, has been demonstrated to be false entirely in this machine, for it is possible to move this 6,000-pound truck up and down the shop floor by simply turning the starting crank; and there seems to be very little difference in the power needed to turn the starting crank, whether the engine alone is being turned or the entire driving mechanism.

Fig. 1.—Differential Countershaft and Rear Axle.

The Countershaft carries three Differentials, and Drives by Chains the Sprockets of Universally-Jointed Shafts which Revolve the Rear Wheels; the Front Wheels are Driven in the same way.

Our illustrations give a fairly comprehensive idea of its appearance and construction. A four-cylinder, 5 x 6 Rutenberance and con-gine of 25 gasoline en-is mounted horse-power, front, and transversely in Morse silent drives by a speed sliding-chain a three-sion immedi-gear transmis-it. Another sion of the from the differen-tial countershaft to the tial in the center shaft placed at the center of the chassis. This counter-shaft has a large differen-smaller one at each end. The large differential takes care of the difference in movement on the two sides of the vehicle, while the small ones equalize the difference between the front and rear wheels, on either side. Sprockets on the hubs of the smaller differentials drive through long adjustable chains the sprockets on the four drive shafts which are connected to the outer face of the wheel hubs through universal joints in said hubs. The outer ends, *E*, of the axle frame are shaped as shown in Figs. 2 and 3. Taper pivot pins, *PP'*, project through holes in the top and bottom of each axle and in the central hub cone-carrying ring, which is flattened on opposite sides so as to fit on the corresponding top and bottom part of the axle end. The bottom flattened portion of this ring (*T*, Fig. 5), as well as the pivot pins passing through the axle end, and half of the universal joint, *U*, of the drive shaft within it, are plainly visible in Fig. 3. The cone ring, *T*, has the steering lever-arm, *S*, cast integral with it, this arm being behind the hub in the photograph, Fig. 3. Two cone rings, *C* are mounted on this ring, *T*, and the cups that match are on each side of a center lug of the L-shaped hub ring, *O*, Fig. 5. Upon this ring, *O*, are mounted segments of wood, which are bolted to it by bolts passing through it and the detachable outer flange, *R*, Fig. 5. These segments are also bound together near the periphery by shouldered rings, *SS'*, bolted on. In putting together the wheel, the inner ring of balls is first assembled on the cone, *C*, of ring, *T*, Figs. 3 and 5. Then the wheel proper, which is built up on ring, *O*, is slipped on, the central lug on the bottom of *O* coming against the right-angled race of one ring of balls. The other ball bearing is then put in place, and both are held in by a retaining ring, which is screwed into place.

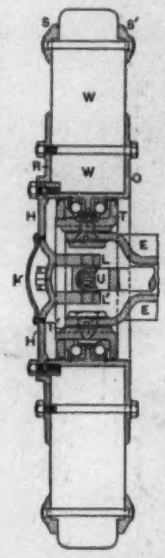


Fig. 5.—Cross-Section of Wheel.

Experience has shown wood wheels of this sort to be cheap and durable for all heavy work. The wheel is driven through a detachable outer hub plate made in two halves (*H* and *H'*, Fig. 5). These halves have lugs, *L* and *L'*, which are assembled around one fork of the universal joint, the other part, *U*, of which is seen in Fig. 3. *H* and *H'* are bolted together and to the outer hub binding ring, *R*. A light hub cap, *K*, completes the hub. In the new model the brake bands will be on a drum on the wheel hub instead of on the sprocket, thus removing from the universal joint the braking strains and leaving it only the driving to do. The brakes, of course, are all connected and balanced by adjustable rods. They are operated by a pedal. By removing *K* and *H H'*, the wheel can be readily removed, as well as the driving shaft. The wood part of the wheel can also be replaced readily at will.

The truck is controlled entirely from the driver's seat. So great is the combined tractive effort of the four wheels, that the machine can be started with its front wheels against the curb, and it will mount it at once, apparently without effort. A very strong company will manufacture the new trucks, which, from present appearances, will meet with as great success as they certainly merit.

Fig. 2.—Rear Axle, Showing Flattened End for Wheel to Turn on, and Driving Sprocket Behind Spring.

Fig. 3.—Ball Cone-Ring Forming Hub, Assembled on Axle End.

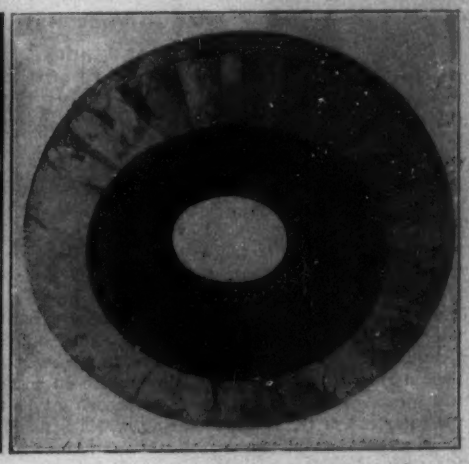
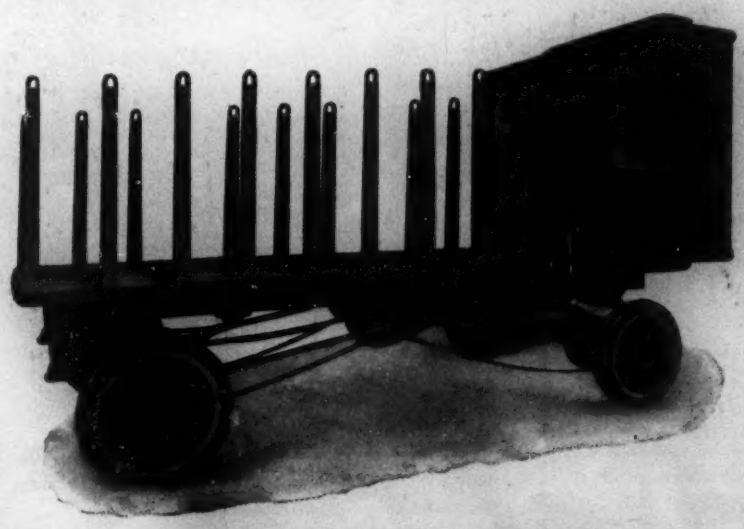


Fig. 4.—Wheel Formed of Wood Segments, Showing Ball Bearing in Hub.

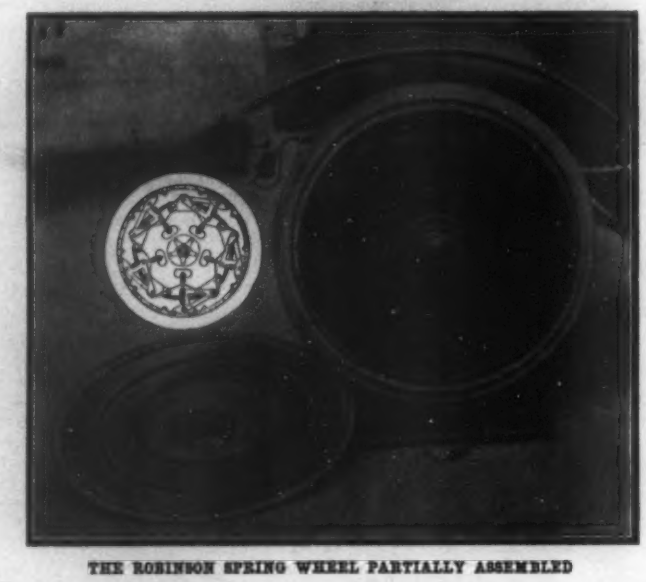


FIVE-TON GASOLINE TRUCK DRIVEN BY ALL FOUR WHEELS.

Paraffin is employed for waterproofing paper. Wax may be used also but is more costly. Either may be applied by melting and drawing the paper through the liquid.—Drug. Circ.

THE NORTHERN TOURING CAR.

In designing their 1905 touring car, the Northern Manufacturing Company have kept the general lines of the light touring car put out by them last year. The main characteristics of this car are a double opposed-cylinder, gasoline motor, placed transversely of the frame, immediately back of the radiator, and having its crankshaft extended into an adjoining case cast integral with the crank case of the motor. In this case, which is separated from the crank case by a partition wall, a planetary gear transmission is mounted to run in oil on the extension of the motor crankshaft, and outside the case the crankshaft is connected by a single, inclosed, telescopic, universal joint, with a housed propeller shaft extending to the rear axle. The drive is by bevel gear and a live rear axle, which revolves in a sleeve formed of two malleable castings, having expanding ring brakes integral with them at their outer ends. These castings are expanded and ribbed to form the differential gear case, and thus an exceedingly rigid axle, oil-tight and dust-proof, is had without any brazed joints. The differential is mounted on independent bearings, so that it cannot receive any side thrust from the wheels. So rigid is the axle that no truss rods are needed, nor are any strut rods required for holding it at the proper distance from the frame. The roller bearings on which it runs are adjustable. The outer ones can be adjusted without removing the wheels. The front end of the chassis contains all the machinery of the car, as can be seen from our illustration. The gasoline motor is mounted at an angle of 11 degrees from the horizontal. The inlet and exhaust valves are seen in the end of the cylinder. These can be readily removed by unscrewing the caps *I* and *E*. The spark plug is in an elbow at *S*. The oil reservoir of aluminium forms a cover, *R*, for the motor crank case. It contains a single sight feed, *F*, and the oil is fed by pressure from the crank case in sufficient quantities to always maintain the proper level. The oil tank can be removed by unscrewing a thumbscrew, and the cranks of the motor are then exposed to view for adjustment. The commutator is shown at *C*. It is of a special form for use with a single coil, and both the primary and secondary currents are commutated, which makes it possible to easily determine which cylinder is missing fire, in the event of uneven running. The motor has a suitable oil pocket which catches the oil and conveys it through a tube to the outer end of the forward bearing, which is babbitt lined. The flywheel of the motor has fan blades, for inducing a draft of air through the radiator. So powerful is this draft, which passes down under the car, that it is said to effectually lay the dust. The motor is controlled by a foot throttle, which automatically locks at any desired point. The clutch lever is a small handle mounted just under the steering wheel. The reverse is obtained by one of the pedals shown, while the other pedal operates the brake. As the rear space of the chassis is unimpeded by machinery, this is filled with two long muffler tubes connected in series. The exhaust, after being expanded in the first tube, passes to the second, or low-pressure muffler, where it is still further expanded and cooled before entering the air. The car is fitted with an adjustable bevel gear steering device and adjustable ball-and-socket joints in the steering connections. A great feature of this form of construction is that the machinery forms a unit in front, and can all be got at from above the car. A form of rotary vane circulating pump is used on the car. The 5¼ x 5¼ motor is of very heavy construction, being built to have a long life. When the car is loaded, its weight is evenly divided between the front and rear axle. The total weight of the car alone is 2,100 pounds. The construction is very substantial, and it should hold up well over all kinds of roads.



THE ROBINSON SPRING WHEEL PARTIALLY ASSEMBLED

APPEARANCE OF SPRING WHEEL AS APPLIED TO A MOTOR CAR.

THE NEW GROUT STEAM AUTOMOBILE.

Grout Brothers, of Orange, Mass., have this year brought out a steam side-entrance tonneau, the chassis of which we illustrate. The boiler, as can be seen, is mounted in front, under a cylindrical bonnet similar to that shown on the National car on page 66. The engine, *E*, is placed horizontally under the footboard, and drives a countershaft behind it by means of a chain. The drive is thence by side chains to the rear wheels. This arrangement makes the engine and all the working parts of the car thoroughly accessible. An auxiliary air pump that may be thrown into action by depressing pedal, *P*, is driven from the countershaft, as is also the water pump. A hand water pump is provided for emergencies. Two force-feed lubricators of novel design supply oil to the engine. A ratchet device driven from the countershaft forces a small cylinderful of oil to the engine cylinders once in a certain number of revolutions, while a gear pump, *O*, forces oil through a pipe having perforations on its under side which spray the oil over all the other working parts. The cut-off and reverse lever is seen behind the dash at *R*. A new form of throttle is used, operated by a small handle, *T*, traveling over a sector under the steering wheel. There is also a little handle, *C*, for by-passing the water. The fire is controlled by the usual pressure diaphragm operated by the boiler pressure. The steam is superheated after passing the throttle valve. This valve is fitted with an interlocking arrangement which closes it when the brake is applied.

The arrangement of the gages and valves in the dash is a very convenient one, and is that which seems to be prevalent on all the new steam cars.

Lane Brothers, of Poughkeepsie, N. Y., also exhibited a car and chassis built on the same lines as the Grout and having numerous valves in the dash, all suitably labeled. The Lane engine is set at an angle of about 45 deg. and is also incased, and the car is fitted with auxiliary steam, air, and water pumps.

The Prescott Automobile Company exhibited the only steam runabout on view. The machine is much the same as that of last year, having a vertical engine under the seat, with chain drive to a live rear axle, and the boiler being in the rear of the body.

A NEW SPRING WHEEL FOR AUTOMOBILES.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A novel type of wheel, specially designed for automobiles, has been devised by Mr. A. S. Robinson, Assoc. M. I. C. E., of Beccles (England), the main feature of which is to supply the resiliency of pneumatic tires by means of mechanical action. The broad principles of the design of this wheel may be adequately gathered from the accompanying photographs and diagram.

(*Continued on page 89.*)

CHASSIS OF THE GROUT STEAM TONNEAU.

A, Air tank; *B*, Brake pedal; *H*, Steering; *G*, Gasoline tank; *O*, Oil pump; *P*, Air pump pedal; *R*, Reverse and cut-off lever; *W*, Water tank.

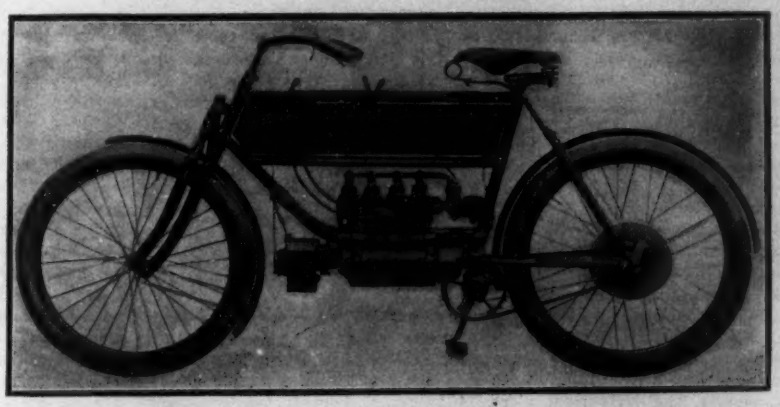
FRONT END OF THE NORTHERN CHASSIS.

C, Contact box; *E*, Exhaust valve cap; *F*, Sight feed; *I*, Inlet valve cap; *R*, Oil reservoir forming cover of crank case.

A FOUR-CYLINDER MOTOR BICYCLE.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The four-cylinder air-cooled motor bicycle shown herewith is of 3½ horse-power. The bore and stroke are respectively 57 millimeters (2.24 inches) and 45 millimeters (1.77 inches). Automatic inlet valves are used. Hitherto the four-cylinder motor has only been used in the construction of automobiles, but any one who has had experience in using them will at once recognize their advantages. An explosion every half revolution insures a much more continuous series of power impulses than one every two revolutions, with the further important advantage that the use of the four-cylinder motor permits a perfect balance between the various working parts being attained. Moreover, vibration is minimized, and the strains in the frame of the machine eliminated. The utilization of the four cylinders also allows greater flexibility in the operation of the engine, the speed varying from 5 to 50 miles an hour. The motors are placed in a perfectly vertical position, which insures the best results, as it is the only one that renders regular and uniform lubrication, together with perfect control of the working parts, possible. Furthermore, the motor is placed as near the ground as is feasible with safety.



FOUR-CYLINDER MOTOR BICYCLE WITH MAGNETO IGNITION AND BEVEL GEAR DRIVE.

The system of transmission is similar to that of the chainless bicycle. There are two bevel gears, one of which is on a longitudinal shaft driven by the motor, and the other is fixed on the rear-wheel hub. The whole arrangement is protected by a dustproof case filled with grease, to insure sufficient lubrication of the various parts.

THOR MOTOR BICYCLE WITH SIDE CHAIR ATTACHED.

To avoid the shocks due to the explosions in the motor being transmitted to the bevel gears, an elastic coupling contained within the flywheel is interposed between them. The high-tension magneto is of a special type and has a current distributor of an entirely new type. The spark produced by this apparatus is superior to that attained by any other arrangement, and more easily controlled, the working parts being fully protected against mud, dust, or rain.

Although perfect regularity of movement is attained by the four-cylinder motor, smooth running of the machine is, however, considerably affected by bad roads. In order to minimize this as much as possible, the bicycle is provided with a special elastic front fork. This embodies a combination of steel springs and some rubber plugs, and has for its object the avoiding of jerks. The fork is noiseless in its action, and conduces to the steady running of the motor.

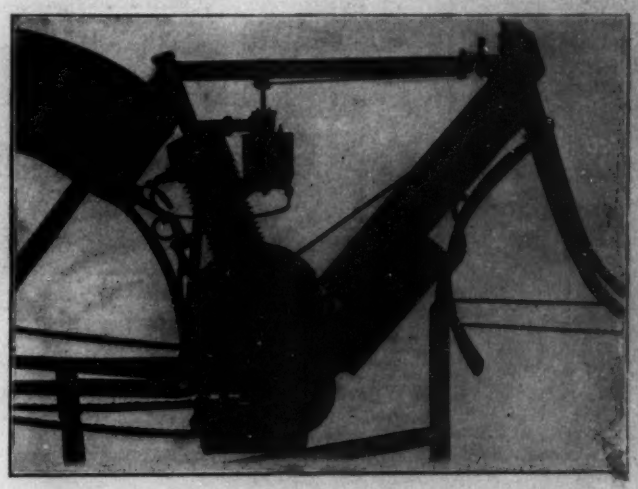
The bicycle is also fitted with a new type of vaporizer, in which a special arrangement produces a perfect mixing of air and gas, thus insuring a complete homogeneity of the mixture. The automatic valve regulates the admission of the supplementary quantity of air at various speeds. There is also a new arrangement for lubricating the various parts of the motor, and distributing oil to the four cylinders in a uniform manner, while the machine is completed by a back-pedaling brake.

The design of the frame has been remodeled in order to embody the new features of this motor cycle. The inferior median part, which supports the motor, resembles a bridle, made of oval tubing, to which the case of the motor is fixed. At the rear end of the case an iron flywheel containing the elastic coupling is fixed on the motor. Above the motor, in the upper part of the frame, are two tanks, the forward one being for oil and the rear one for gasoline. To facilitate starting, a lever is placed on the handle bar, by means of which the exhaust valves in the cylinders can be raised to release compression. The motor can then be started by pedaling a few strokes.

The regulation of the speed is obtained by moving one or both of two levers placed above the gasoline tank, one of which varies the ignition, and the other limits the quantity of gas entering into each cylinder.

The machine has two brakes; one of these is operated by back-pedaling. The ratchet wheel fixed on the bottom bracket actuates a rod, which moves two jaws, which thus exert pressure upon a drum fixed on the rear-wheel hub. The other brake is composed of two long shoes acting upon the rear-wheel rim. This brake is operated by means of a lever placed on the handle bar and which, by the intermedium of rods, forces the shoes in contact with the rim of the wheel.

besides the two-to-one gears and cam for operating the exhaust valve. The contact device is also shown on the side of the crank case at the front. A curved spring attached to the contact box rubs against a spring-pressed button, from which a wire runs to the spark coil. This curved spring acts as a switch, and in the position shown in the photograph, it makes contact and completes the circuit to the batteries. When the contact box is moved back as far as it can travel by means of the rod connection running to a lever on the front fork, operated by a rack-and-pinion arrangement from the lever on the handle bar, the curved spring just mentioned moves away from its opposing contact and breaks the ignition circuit. At the same time the top of the box strikes a lever, which raises the exhaust valve and holds it open. This lever, and its withdrawing spring, can plainly be seen in the illustration, beside the curved spring and contact box. It will thus be seen that when the exhaust valve is raised, the current is always automatically cut off. The carburetor is also shown in section, but is too minute to be described here. It draws its air from around the ribs of the motor through a small funnel at its base. Another feature to be noted is that the inlet valve stem projects through its housing, so that if the valve should stick it could readily be punched away from its seat by pressing the stem on the outside. The motor is oiled from an oil cup on its base, which in turn is fed from an oil tank above. The gasoline tank is arranged over the back wheel, while the forward member of the diamond frame carries the batteries in a case above it and the spark coil below. The motor, as can be seen, is built in the diamond frame in such a way that it forms part of the upright



SECTIONAL VIEW OF THE THOR MOTOR AS USED ON A BICYCLE.

A NOVEL SIDE-CHAIR ATTACHMENT FOR MOTOR BICYCLES.

The accompanying illustrations show an entirely new arrangement for carrying a second person with a motor bicycle, and a photograph of a motor showing the parts in section. The attachment and motor bicycle are both made by the Aurora Automatic Machinery Company, Aurora, Ill. The motor is known as the "Thor" motor, and the sectional photograph is made from a working model exhibited at the New York Automobile Show. This sectional model of the motor, which is a very neat piece of work, shows the inlet and exhaust valves operating in their valve chamber, into which the spark plug projects. The crank case has been cut away so as to show the flywheel revolving therein, post which screws into its head. It drives the rear wheel through a chain and an ingenious cushion sprocket having a diamond-shaped groove in which a brass ring of the same cross section is clamped between the driving and driven parts. This, and the method of confining the wiring to the motor, and thus dispensing with running the wires through the handle-bar, are the main features of the Thor motor bicycle. The bicycle attachment consists of an extensible axle attached to the axle of the rear wheel, and a curved tube extending from the end of this axle to the steering fork, where it is firmly attached. A wide seat is mounted upon this side carriage. It is so constructed that it can be quickly converted into a box for packages. The side carriage can be quickly removed when not needed. The attachment forms one of the neatest solutions of the small automobile problem that has yet been made. The motor bicycle has ample power to draw it over not only ordinary, but also poor roads.

A BOY'S HOME-MADE BUCKBOARD.

The buckboard automobile, also shown on this page, was constructed by two New York boys after their own designs. A Thor motor is used for propelling it, and this drives a countershaft by means of a belt, from which the transmission is made by chain to the rear axle. The machine is mounted on 28-inch bicycle wheels, and steered after the manner of a bob sled, with a handle.

THE NATIONAL TOURING CAR.

A company which has up to the past year been identified chiefly with the electric vehicle industry, but which then brought out also a gasoline machine, that, with the improvements and changes wrought upon it, is now one of the best-built and up-to-date cars on the market, is the National Motor Vehicle Company, of Indianapolis, Ind. A thorough inspection of the company's plant and a ride at high speed over the rough roads in the vicinity, convinced the representative of this journal that the National car is one that will stand abuse.

The general appearance and some of the details of the car are shown herewith. A four-cylinder vertical motor specially made by the Rutenber Company is used. The view showing the motor taken apart gives a good idea of its appearance. Separate, integrally-cast cylinders having mechanically-operated, interchangeable inlet and exhaust valves in a common valve chamber are bolted to the crank case. The bore and stroke of the cylinders and pistons are 4½ and 5 inches respectively and the compression 80 pounds. The valve stems are raised by plunger rods having rollers against which the cams strike. The bronze bushings for these plungers, seen bolted to the crank case, are removable and can readily be replaced. There is but one cam shaft, supported in three bearings. The aluminium crank case is divided into four compartments, and the crankshaft has five bearings. The three center ones hold the shaft in place when the bottom of the crank case is removed to adjust the crank or wrist-pin bearings—a feature which is found on most four-cylinder cars this year. Besides this, there are liberal hand holes in the crank case, as shown. Babbitted adjustable bronze bushings are used throughout. The pistons have four ¼-inch rings and hollow wrist pins. The connecting rods are drop-forged, and the crankshaft also is a forging. The flywheel is bolted to a disk on the crankshaft. The contact box in front of the dash is on the end of a vertical shaft driven by spiral gears, and in the same casing is a ball governor which operates on the spark, and can be set for any desired speed by a lever on the steering wheel. The main control of the car is by a throttle pedal, as well as by a throttle lever on the steering wheel. A gear water-circulating pump is driven direct from the single cam shaft of the motor by means of an ingenious detachable coupling. The removal of four bolts disengages the whole pump. The cylindrical honeycomb radiator is backed by a six-bladed, belt-driven, ball-bearing fan 19 inches in diameter and geared to run three times as fast as the motor. On account of the shape of the radiator, the fan produces a draft of air throughout its whole extent. Jump-spark ignition is used, the current being furnished by a belt-driven Apple dynamo, and the secondary wires from the four spark coils to the plugs being rubber covered and run through fiber tubes. Chain connections, which act as spark gaps, are used to the plugs.

The clutch of the new National car is constructed according to the latest French practice. A cast aluminium cone, leather-covered, has six slightly-arched, flat steel springs, placed in suitable pockets between the cone and the leather. These springs press out the leather slightly and cause the clutch to take hold easily—so easily, in fact, that the car can be started gently on the high speed with the engine running very rapidly. The clutch is interlocked with the brakes and gear-shifting lever so that the application of either brake or changing the gears throws out the clutch automatically. The usual clutch pedal operates the clutch also in the regular manner. The clutch is connected to the transmission through a universal coupling that allows of fore-and-aft movement as well as misalignment. Both the main shaft and the countershaft of the transmission run on ball bearings. The former has two rings of balls at each end and the latter but one. The balls are of large diameter, and all the bearings can be readily adjusted from the outside of the case. The entire top of the case can be removed for inspecting the transmission without disturbing any part of it, as can be seen from the cut, Fig. 3. The operation of the modern three-speed sliding transmission. The main shaft is squared and carries the sliding set of two gears, 1 and 5, cut from one piece. A groove, *G*, between the two gears receives a shifting fork for sliding the set. This fork is mounted on a rod that can be slid lengthwise of the case from the outside. The end which is connected to a lever passes through a stuffing box with felt washers, while the other end moves in a sealed tube attached to the gear case. All these provisions are made to keep out the dust. The shorter of the two levers at the side of the car slides the gears. The position shown is low speed. The drive is here from gear 1 on the square shaft, *A*, (which is connected to the clutch and has a bearing in the rear shaft, *B*, at *S*), through gears 2 and 3 on the lay shaft, to 4 on shaft *B*, whence the power is transmitted through the universal joint and longitudinal driving shaft (see plan of chassis) to the rear axle. By sliding gears 1 and 5 to the left until 5 meshes with 6, the intermediate speed is obtained; while sliding the set still further causes lug, *L*, to slip into space, *S*, between the corresponding lugs on gear, 4, thus locking *A* to *B* and giving a direct through drive on generous ball bearings from the motor to the rear axle. The reverse is obtained by causing gear, 1, to mesh with gear, 8, and gear, 2, with gear, 7, which is slid in mesh with 2 automatically by 5 engaging a washer beside 7 as it slides sideways, and thus pushing 7 along into place against the compression of the spring, which thrusts it back out of mesh as soon as it is released. Thus, although the lay shaft is turning all the time when the main shaft is revolving, the reverse pinions are idle except when in use. So compact and light is this transmission that it weighs only 70 pounds, while the weight of the motor is 380.

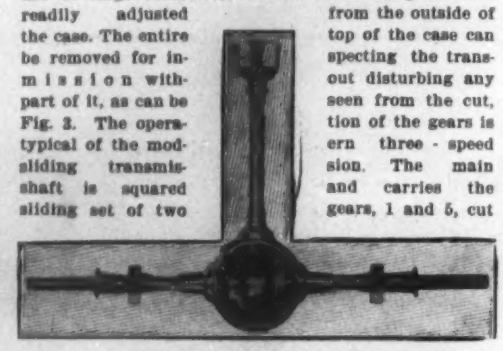


Fig. 1.—PROPELLER SHAFT AND REAR AXLE, WITH DIFFERENTIAL COVER REMOVED.

The longitudinal driving, or "propeller," shaft as it is usually called, runs in ball bearings in a steel tube extending from the globe-shaped differential casing to the rear end of the transmission case, where it is supported by a yoke pivoted on a cross-member of the frame (Figs. 5 and 6) so that it can move back and forth sufficiently to allow for the up-and-down movement of the frame. A protected universal joint between the transmission gear shaft and the propeller shaft completes the line of shafting. The bevel pinion fits on a squared end of the propeller shaft and is held in place by a nut and cotter key. The gears used are of four pitch, both hardened; and a speed reduction of 3 to 1 is obtained.

The construction of the rear axle is such that the rear axle tubes extend through the wheel hubs. On the outside ends of these tubes suitable cones are provided, the outermost of which is adjustable by nuts threaded to the exterior diameter of the tube, thus providing a double, adjustable ball bearing for the wheels entirely independent of the driving axle. The differential case is securely brazed to the two lengths of cold-drawn tube, thus making one homogeneous whole from outside to outside of wheels. It is provided with a removable cap (Fig. 1) by dividing it above the axle lugs in a horizontal plane, thus providing means of inspection of differential gears by simply unscrewing this cap. Inside the case two rows of balls affixed to it provide ball bearings for the hubs of the differential. One of these bearings is equipped with a split cap, which, being held in place by two studs, can be removed, and when removed allows the withdrawal of the entire differential and large gear intact through the opening in the top of the case. Thus we have the wheels turning on the outside of the rear axle tubes, and the differential revolving on its own bearings inside the case, but independent of any strain or stress from weight of car or load. Application of power to the wheels is obtained by means of the two inner axles engaging the gears in the differential by means of squared holes in said gears, the outer end of each axle fitting a squared jaw clutch, which in turn engages its mate upon the hub of the wheel, this engagement being made at the outer end of the hubs, and the whole being covered by dust caps. The advantages of this system are the perfect running of gear and pinion, they being firmly held in place by their bearings; freely-turning wheels due to double ball bearings; a rear axle without joint from outside to outside; the removal of all side thrust from the differential. The adjustment of the wheels does not affect their bearings. As an additional precaution, although not necessary with this system, a truss rod of circular section, ⅝ inch in diameter, extends from the brake support on one side downward and under the center of the spherical case to the brake support on the opposite side. This system also dispenses with reach rods, while the rear axle is provided with movable spring perches mounted on the axle, so that it can rock back and forth without straining the springs. The differential is of the spur gear type, and is of heavy construction. The National Company is

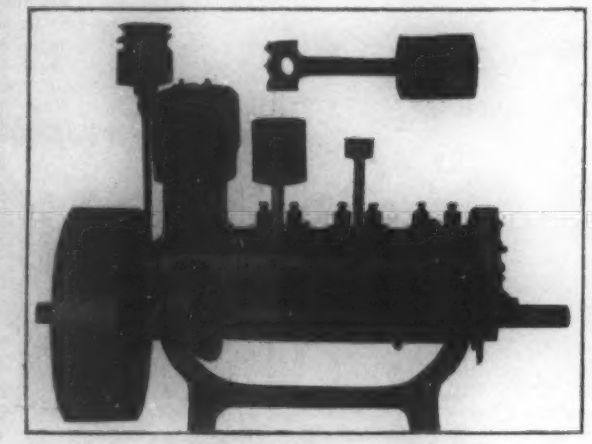


Fig. 2.—MOTOR PARTIALLY ASSEMBLED.

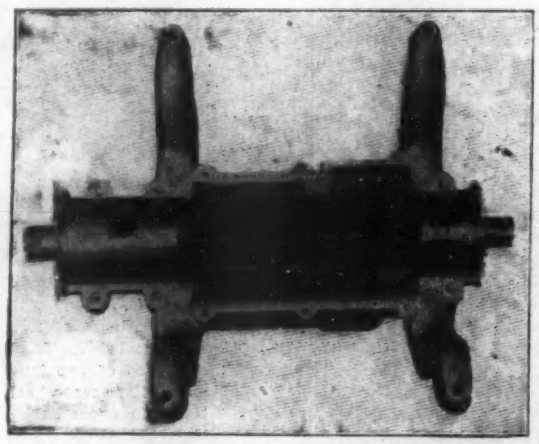


Fig. 3.—TRANSMISSION GEAR WITH BALL BEARINGS.

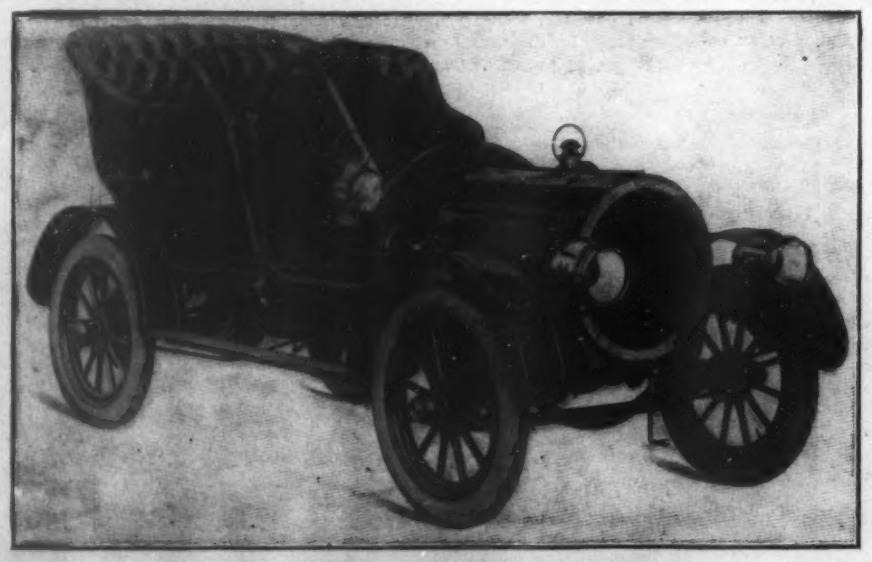


Fig. 4.—THE NATIONAL 24-HORSE-POWER TOURING CAR.

the liberal use of ball bearings are following the latest practice of the best French engineers, some of whom carry the use of ball bearings even to the engine crankshaft bearings. The liberal use of balls undoubtedly reduces friction, and enables the engine to deliver the maximum amount of horse-power to the ground.

The car is fitted with 34-inch artillery wheels, all of which run on double adjustable ball bearings, fitted with ball retainers and made dust-proof by means of felt washers. The front wheels turn upon heavy drop-forged spindles, which are a part of the combined forged knuckle, spindle, and steering arm. The wheels are shod with 4-inch tires, and have the standard tread. The hubs are fitted with spherical dust caps. The rear hubs carry brake drums 13 1-12 inches in diameter with 1½-inch internal face, which provide the friction surface for the internal-expanding metal-to-metal brakes. The system of bearings provided for the wheels allows for the replacement of wearing parts. Replacing the cups, cones, and balls makes a new bearing, regardless of length of service.

On the rear side of the dash, as shown in Fig. 5, are four spark coils in a case and four sight-feed oilers, as well as a snap switch for the ignition current. Extending through the dash is one end of the compression relief rod, which engages the four relief cocks on the cylinders of the engine. The oil supply cut-off extends through the dash also. The oil can be regulated by a button, which is on the end of this rod. The oil is fed to the bearings of the transmission, the universal joint, and the motor crank case.

A good feature of this car that might pass unnoticed is an extra set of lever arms on the steering knuckles, connected by an extra tie rod. In case one of the lever arms should break, as sometimes happens, the extra set would still steer the machine. The main frame of the car is of pressed steel, and the machinery is all carried on a subframe. The car has a long wheel base, which contributes to its easy-riding qualities. The ease of control and of adjustability of mechanism, besides several features of the latest foreign practice, stamp it as one of the most up-to-date American cars.

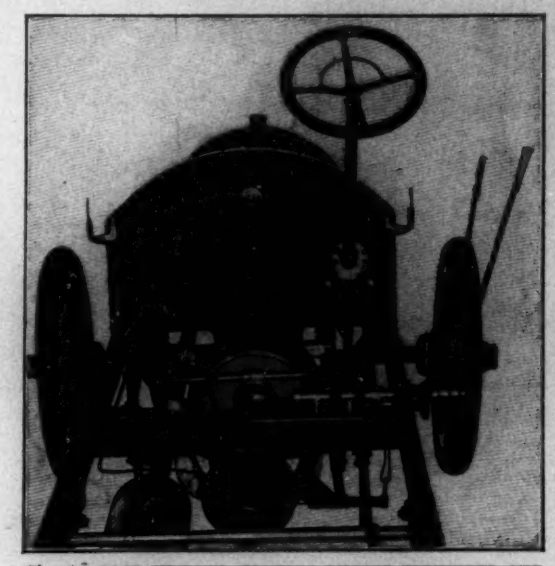


Fig. 5.—BACK OF DASH, SHOWING ENGINE FLYWHEEL AND UNIVERSAL JOINT OF PROPELLER SHAFT.

Sir Oliver Lodge on Internal Combustion Engines.

For about two hours last December Sir Oliver Lodge interested a large number of members of the Automobile and Cycle Engineers' Institute, assembled in the hall of the Institution of Mechanical Engineers in London, with an address, illustrated by lantern slides, and experiments with apparatus, on the subject of ignition as applied to internal combustion engines.

Sir Oliver said he would make no distinction between oil engines and gas engines, but take a general survey of the whole subject. From the point of view of combustion, a gaseous mixture was the best. For the purpose of ignition the combustible mixture had first to be raised to a temperature at which combustion took place, and it then spread until it ignited the rest of the gas. Rarefaction, or diminished pressure, would prevent ignition spreading, while a rise of temperature would assist combustion or explosion. The lighter the explosive gas the quicker was the movement of the molecules, and as it had been found, he said, that in gas engines the quickest combustible mixture was that in which there was a slight excess of hydrogen, or the lighter material, one would have thought that an excess of either material would be a disadvantage; but that did not appear to be the case, although an excess of the heavier material proved disadvantageous because the atoms forming it were moving more slowly. The effect of a diluting material was the same as that of rarefaction. Each gas occupied a space independent of the rest, and dilution with other gas might have a retarding effect on combustion. In a weak mixture the line of explosion would be a meandering one, and the explosion would be slow. To increase the rate of combustion the gas must be compressed and then ignited in more than one place. It was sometimes asked whether it was better in a cylinder and piston to ignite the gas near the piston or near the base of the cylinder. In a high-speed engine the best place would be near the piston, so that the force of the explosion might be exerted on the piston before it could move away. The quicker the speed of the engine the more combustible must be the material used. In a slow-speed engine a slow-burning mixture might be used without advantage, because a more lasting blow—more of a push—was obtained. If the walls of a gas engine cylinder were cold there was bound to be a certain amount of unburnt materials. If they could have the walls of the cylinder red hot they would obtain better combustion. He could not think the principle of a water gas engine was right or final, because in it the temperature of that which they wanted to be hot was lowered. If only they could let the air and gas into a hot vessel it would certainly be more economical. It did not seem beyond the province of invention to achieve that result. He thought the subject of ignition important, and it was in that direction that advance had largely been made. The idea of modern guns—barrels, powders, and shot—was not very different from what it was years ago. It was in the ignition arrangements that the modern rifle differed chiefly from the ancient weapon, and the same was the case in engines. Sir Oliver then illustrated several methods of ignition—the tube ignition method, the incandescent tube igniter in which the time of explosion is regulated by the screwing in or out of a timing plug, Wydt's electro-catalytic igniter, and the Clerk engine, with bolt igniter, in which a piece of metal kept hot by the previous explosion causes an explosion as soon as the gas is compressed by the return of the piston. Having shown that a little spray of oil injected into compressed hot air is all that is needed to secure ignition, the lecturer pointed out that the temperature of the highly compressed air lasted only a short time because it was in touch with cold surfaces. In motor cars and portable engines especially flame ignition was hardly ever employed, and therefore electric ignition had come to the fore. Electric ignition might be regarded as almost the natural method of setting up combustion. Sir Oliver showed a number of experiments in electric ignition by both low and high tension methods. Finally he illustrated the quickest method of obtaining an electric spark—a plan which he described as equivalent to the release of an electric spring. From a coil two wires were carried to a couple of Leyden jars in order to charge them, and the discharge from the interior of those jars caused a spark where points on the charged wires were brought into juxtaposition. But if from the external casing of the jars other wires were carried and their points were brought toward each other, a spark could be obtained which could not be stopped by the interposition of an electric-light carbon or wet blotting paper, or by the points being smeared with a mixture of lampblack and oil, or being placed under water His son had told him of the trouble sometimes experienced with motor cars owing to failure of ignition, and he thought the second spark of which he had spoken was what was needed to remedy this. He was informed that people often wanted to economize in the ignition arrangement of motor cars more than in any other part; but that seemed to him false economy. There was much that was beautiful and well and skillfully designed in connection with these engines, and sometimes the ignition part was not equal to the rest. He thought more attention should be directed to those parts.

Important alterations have been made concerning the international contest for gasoline-propelled boats for the Harmsworth trophy. Henceforth the start is to be a flying one, all competitors starting together by signal. The course is to be extended from the present length of between 6 and 12 knots to one varying from 30 to 35 knots, so that opportunity is provided for the evolution of a better type of boat. All angles also must not be less than 120 degrees, and the length of each round is not to be less than five nautical miles.

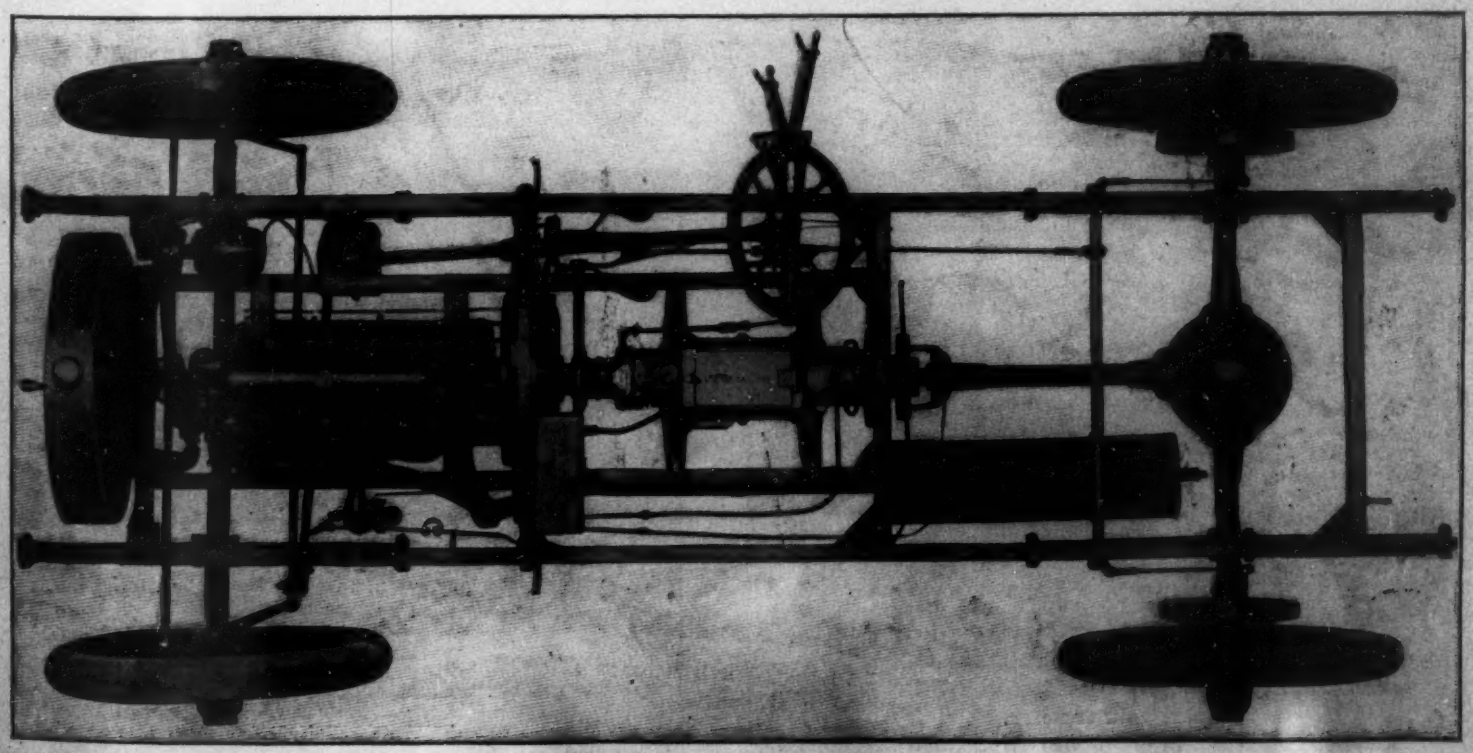
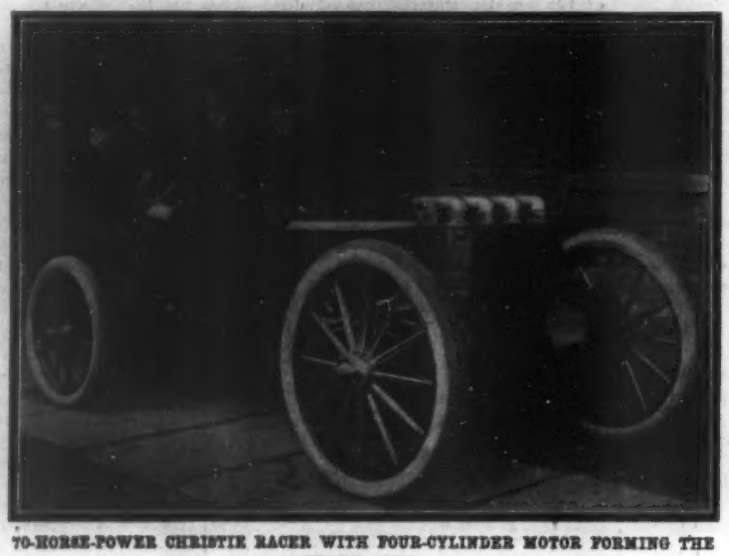


Fig. 6.—CHASSIS OF 24-HORSE-POWER NATIONAL TOURING CAR.

A NEW AMERICAN AUTOMOBILE.

Our illustrations depict a distinctly American machine of a new type, the original of which made its debut at Ormond Beach a year ago, and despite cut cylinders from running out of oil, made the fast time of a mile a minute. Since then Mr. Walter Christie, of this city, the inventor of the car, has constructed a much larger racer, and with this he has gone to Florida again, with the hope of making some speed records. If he is successful this year at Ormond during the present week, he may afterward enter the long-distance road race, which is to be run off in Cuba. The new car, as can be seen from the photographs, is quite simple. It consists of a front axle formed of the motor crank case and suitably attached to the side bars of the frame. The ends of the crank case are brought out somewhat in the shape of a forked steering knuckle (*EE* in diagram), and the upper part of the fork rests upon a cap which slides over the vertical part, *P*, of the steering spindle, upon which it is supported by a stiff coiled spring. The front wheels revolve on ball bearings on the steering spindles, being driven by universally-jointed shafts, which pass through the hollow spindles and are keyed in the outer ends of the wheel hubs. The two universal joints are seen at *UU*. The rear wheels are also fitted with ball bearings and band brakes. It will thus be seen that while the motor is on the front end of the car, as is the case with most modern automobiles, the construction differs from that usually employed, in that the motor is set transversely on the chassis and drives the front wheels direct. All that part of the car behind the front axle is a trailer for the axle; and as the machine draws instead of pushing itself, there is not liable to be trouble from skidding; besides, this method of propulsion consumes less power, as determined by electrical tests. The chief charm of the new construction, however, is the direct application of power to the wheels. Each flywheel, *F*, of the motor forms a conical clutch inlaid with segments of leather, which does away with the usual method of riveting on the leather in a band. These cone clutches engage drums, *D*, which slide on and drive through a considerable number of keys located at *K*, the inner end of the short universally-jointed drive shaft that has one bearing in the motor crankshaft and the other in the wheel, to the hub of which it is keyed. The driving sleeve or cup attached to *D* has a bearing, *R*, on rollers in the crank case extension. This sleeve and drum, *D*, is slid to the left by ball bearing fork, *B*, when flywheel clutch is out. The middle section of the inner drive shaft is that having the two forks for the universal joints, while the outer end drives the wheel as mentioned above. The pins used in the universal joints are hollow and are packed in grease. A 5,000-mile test has shown practically no wear here. When the clutches are in, the motor crankshaft is locked to the wheels. No differential is provided for the direct drive on the present car, but one could be incorporated in the flywheel or wheel hub should a commercial car be built and a differential be found necessary. At present the springs used to hold the clutches in place are light enough to allow sufficient slippage to take care of the differential movement. When on the low speed or reverse, a differential on the countershaft is in use.



70-HORSE-POWER CHRISTIE RACER WITH FOUR-CYLINDER MOTOR FORMING THE FRONT AXLE.

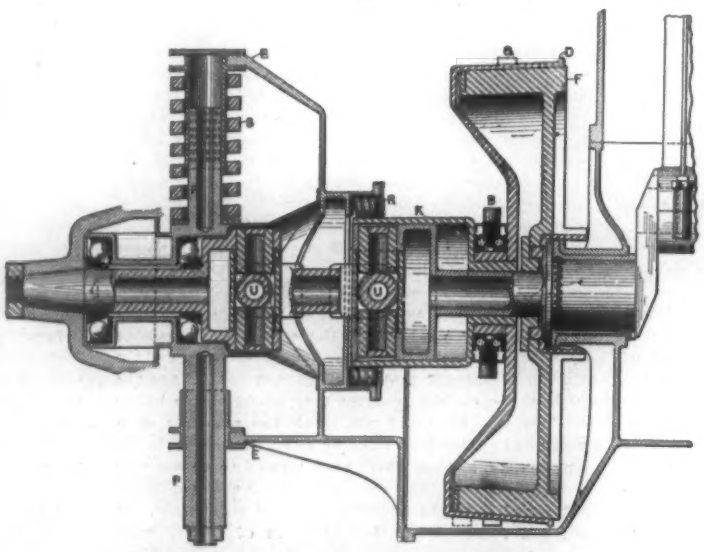


DIAGRAM OF CHRISTIE DIRECT-DRIVE MECHANISM.

The drums which the flywheel cones engage each carry a large gear ring, *G*, on their periphery, and these rings are driven by small gears on the ends of a countershaft, which receives its motion from a short countershaft above it, driven at a reduced speed by a large gear on the two-to-one cam shaft that operates the exhaust valves. By engaging one or the other of two gears on this shaft with a gear on the main countershaft, and throwing in the small cone clutch, the low speed and reverse are obtained. Thus it will be seen that the present car has all the essential parts of any ordinary automobile, including the differential; and it is by no means as much of a freak as a car exhibited at the Paris show, which will be found described in the SUPPLEMENT for January 7. This car has no low speed or reverse, the latter being obtained by reversing the motor, and the drive being through a friction clutch and longitudinal driving shaft to a countershaft, and thence by chains to the rear wheels. A specially constructed clutch that can be allowed to slip without damage replaces the low-speed gear. A combination of this idea with that of Mr. Christie would give an ideally simple car.

The four-cylinder motor used on the present car is of about 70 horse-power. It has a 6¼-inch bore by 6¾-inch stroke, and will drive the car 90 miles an hour when making 792 R. P. M. The 40-inch wheels make one revolution with every turn of the engine crankshaft, and the car advances 10 feet per revolution. The inlet valves of the motor are automatic and are eight in number for each cylinder, being arranged in two circular plates, as shown. There are 32 inlet valves altogether, and all are of the flat-seated variety. A single large exhaust valve is used for each cylinder. An automatic carbureter having a multiplicity of tiny automatic valves (similar to the inlet valves of the motor), for admitting the auxiliary air, is used. The gasoline tank is under the rear seat, the fuel being forced to the carbureter by air pressure. The ignition is by jump spark from coils with vibrators and a three-cell storage battery. The contact device is a ring of fiber with steel contacts. A steel roller moving around within the ring is used to make the contact. The rear part of the bonnet is made up of twelve sections of finned radiating pipes, there being eight 5-16-inch pipes 64 inches long and carrying 340 5 x 1-inch fins to a section. A total of over 20,000 square inches of radiating surface is thus obtained. The pipes are of copper and the fins of aluminium, and both are coated with lampblack. From a vertical cylindrical copper tank in front of the radiator, the water is forced by a gear-driven gear pump through the radiator and into the bottom of the water jacket on each side of the motor. A pipe running across the top of the motor, and connecting with the water jacket between each cylinder, carries the hot water to the vertical cylinder, thus completing the circuit.

The controlling levers, spark coils, sight-feed oiler, and water-pressure gage are all at the rear, directly before the driver. The ignition current may be instantly cut by the switch on the steering wheel.

FRONT VIEW OF MOTOR.

One Inlet Pipe is removed, so as to show the two large inlet valve plates, each of which contains four flat-seated automatic valves.

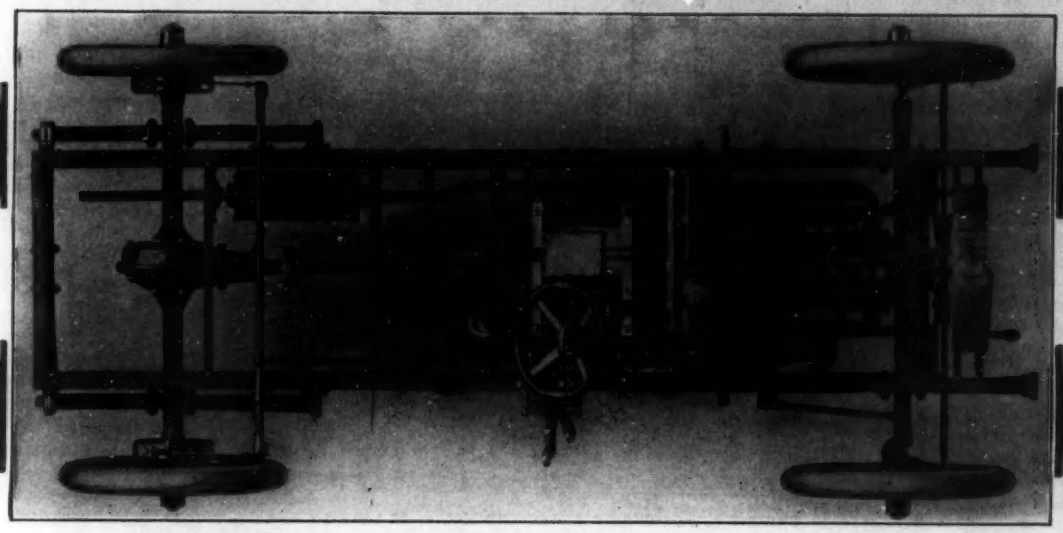
REAR VIEW OF MOTOR.

The Carbureter, Spark Plugs, Cylindrical Water Tank, Radiator, Exhaust Pipes and Valve Stems, and Transmission Gear are plainly to be seen in this cut.

The Autocar

THE CAR OF SIMPLICITY

CHASSIS OF TYPE XI



Type XI Four Cylinder 16-20 H. P.

Double Side Entrance Tonneau $2,000

The Autocar stands as a triumph in automobile building. Its construction combines with greatest efficiency and durability a simplicity that is the wonder of all who see it. This is a feature that commends itself alike to the novice and the expert. It means minimum liability of derangement, greatest ease and safety of operation, and lowest running expense. Each type of Autocar represents the nearest to perfection in its class. Every Autocar is built upon lines proven correct by experience; built of absolutely the best material, and with the best workmanship procurable.

Autocar records of actual performance bear out the claim that for good day-in-and-day-out, up-hill-and-down service, for durability and freedom from annoyance, the Autocar is unsurpassed.

The new car, Type XI, illustrated above, with its chassis, shows a number of very valuable improvements, accomplishing increased ease of control, safety, and simplicity.

Type VIII, Four-passenger car, and Type X, Runabout, are the cars which have made the present reputation of the Autocar, to which the new Type XI will surely add.

Write for catalogue and dealer's name.

THE AUTOCAR COMPANY, Ardmore, Pa.
Member A. L. A. M.

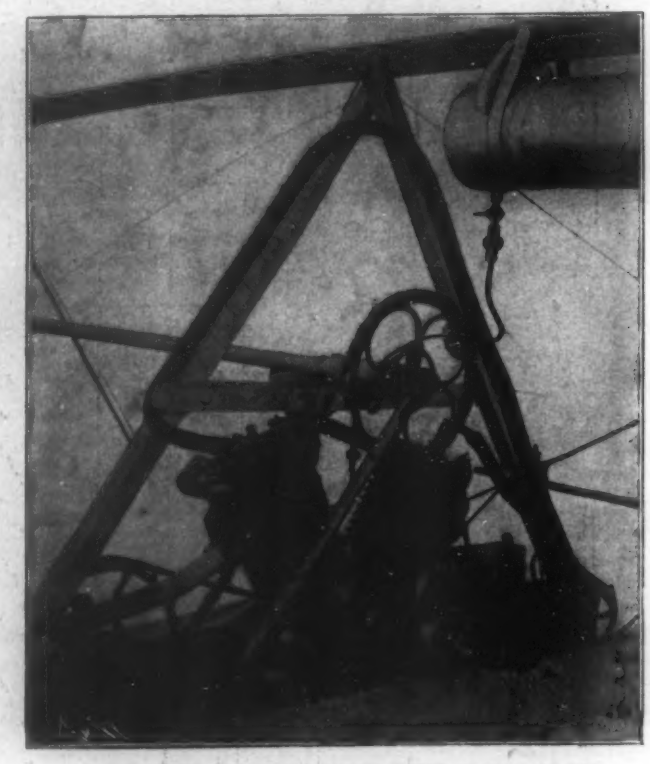
Type X 10 H. P. Runabout $900

Type VIII Rear Entrance Tonneau $1,400

A POWERFUL LIGHT-WEIGHT GASOLINE MOTOR.

The V-shaped motor shown herewith is a 5-horse-power air-cooled bicycle motor that has met with great success for other purposes during the past year. Beginning with making a 10-mile record in 8 minutes, 45 2-5 seconds at Ormond Beach last January, when used on a motor bicycle, one of these motors finished by driving the only successful airships at the St. Louis Exposition, and by making a record in aeronautic work on Christmas Day, when one drove the Baldwin airship 20 miles in 1 hour, 13 minutes, against a 13-mile-an-hour wind for half the distance.

The motor is built with the cylinders set to form a V in order to economise space as much as possible. The crankshaft runs on roller bearings, which reduce friction to the minimum and do not wear out readily. The bore and stroke of the cylinder and pistons are each 3 inches and high compression is used. The motor develops its full horse-power at 2,000 R. P. M. On the Benbow airship two of these motors, coupled together, were used. The Baldwin airship, which has a 15 x 45-foot balloon, and a framework 21 feet long by 3½ feet wide, was propelled by a single motor like the one here shown, which weighs complete but 60 pounds. The Curtis Mfg. Co., of Hammondsport, N. Y., is the maker of this little engine.



5-HORSE-POWER CURTIS AIR-COOLED MOTOR AS USED ON THE BALDWIN AIRSHIP.

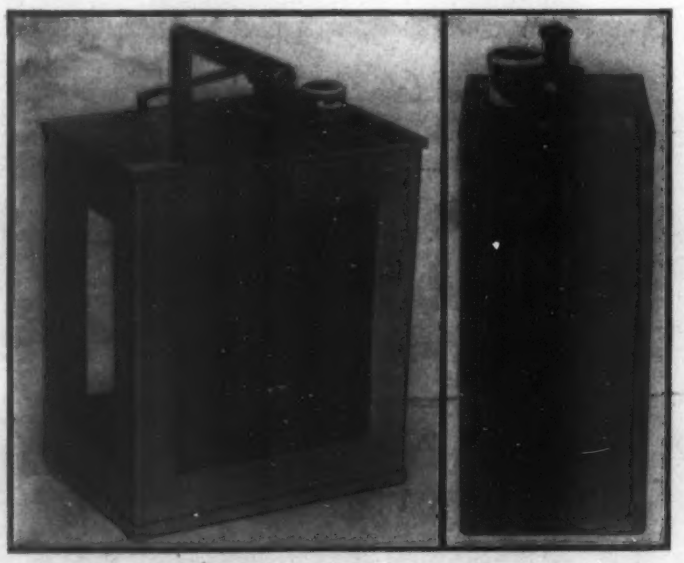
IGNITION ACCUMULATORS.

Two or three storage cells can be used on every gasoline automobile for ignition and for furnishing electric light. When so used, if they are of a good make and of sufficient capacity, they will be found to give excellent results. On a single or double-cylinder car, cells of 40 to 50 ampere-hours capacity should be employed, while a four-cylinder machine should have cells of double the size. These should assure the good running of the engine for several thousand miles, and they can then be recharged from any ordinary direct-current electric-light circuit, whereupon they will be found as good as new. This recharging can be repeated hundreds of times, and the life of a well-constructed ignition accumulator should extend, provided the cell is properly treated, over at least five years. As the storage cell is a reservoir of electric current, it is capable of supplying electricity for lights as well as for ignition. With a properly-constructed parabolic headlight, it is astonishing what a powerful light can be projected with a lamp of but 3 or 4 candle power and of about an ampere current consumption at a voltage of 4 or 6 (two or three cells). Every extra light that is burned on a machine necessarily tends to run down the battery more quickly, so that if more than two are regularly used, it will be advisable to either have a larger battery or a small dynamo on the machine for recharging. Almost any good ignition dynamo can be arranged with an automatic switch, so that it will charge the battery as soon as it comes up to speed. With an arrangement of this kind a battery of small capacity can be used.

One of the neatest ignition cells now on the market is the "Duro," which is made in Chicago. A specially constructed grid sawed out of a lead plate is used in this cell, and the spaces between the plates are filled with a jelly electrolyte, thus making the cell practically a dry one. The hard rubber battery jars are packed in a copper carrying case, which is substantial and non-breakable, and, being coated with acid-proof paint, is not liable to attack from acid fumes. The makers of the "Duro" battery also furnish lamps of various types to be used with these accumulators. Among these are extremely efficient parabolic head lights, suitable side lights, tail lights, and a small lamp with flexible cord for investigating the machine in case of a breakdown.

The "Vesta" accumulator is another Chicago product that has been meeting with considerable success. The plate used in this cell is also of the pasted type, the grid being in two halves which are pasted and then pressed together, thus locking the active material between diagonal ribs that cross at right angles. The "Vesta" cells are neatly incased and lamps are furnished to go with them if desired.

Undoubtedly the finest ignition accumulator made in America is that put out by the Storage Battery Supply Co., of this city, and which is shown in the annexed cut. The plates, of the usual pasted type, are hung from supports on the inside of celluloid jars and are spaced 7-32 of an inch apart and suspended with their bottoms ⅝ of an inch above the bottom of the jars. On account of the wide space between plates, separators are unnecessary, while the condition of the plates can always be seen through the transparent celluloid jars. Celluloid jars are used very generally abroad for ignition cells, but the "Reliance" is the only American battery put up in jars of this material, which is exceedingly tough and can be hermetically sealed at all joints, thus making it free from the moisture of acid fumes and the usual corrosion. The same company also puts up a cheaper cell in hard rubber jars. Both types are fitted with patented plugs which prevent the spraying of the electrolyte when the batteries are gassing freely upon being recharged.



RELIANCE IGNITION ACCUMULATORS.

The plates are suspended in celluloid jars and properly spaced apart without the use of separators.

Ocean-Going Motor Boats.

Mr. W. E. H. Humphries, a Cambridge science graduate who has devoted himself to the study of the use of high-power internal combustion engines for submarine vessels and is a practical motorist of wide experience, writing on motor-boat building in the publication To-day, says that the folly of those makers who propose competing in the Atlantic motor-boat race with 40-foot boats furnished with 100-horse-power motors should be apparent, when he states that they would require for the journey 15 tons of fuel, which would occupy more than the whole cubic space of the hull. Mr. Humphries fears that many of the competitors in the trans-Atlantic race will fall into the mistake of throwing any handy big engine into any convenient boat without regard to the question of design, proper engine bed, distribution of weight, etc. The motor boats which crossed the English Channel, "excellent as they were for their own particular purposes, were more or less freak boats," because in design they fell away from the lines normally maintained in marine practice. In yacht designing "the highest ambition of those who aim at speed is to exceed a speed in knots greater than the square root and a quarter of the vessel's length. The Atlantic liners cannot do it; motor boats and the torpedo-boat destroyer can, but such speed is only attainable at enormous extravagance and by making the vessels mere receptacles of vibrating machinery and limiting their range."

Writing on this subject for the Pall Mall Gazette, he expresses the opinion that—

"To cross the ocean in a manner to fulfill the published details a boat must be nearer 400 feet than 40 feet. The conditions of the race are that the boats shall be able to travel at a speed of at least 15 knots, shall carry all their own fuel, lubricating oil, and spare parts, and shall start with at least six persons on board. This at once rules out of the contest all small racing craft, for, apart from questions of accommodation and seaworthiness, they could not carry the fuel to feed their engines. The normal consumption of a petrol engine may be regarded as 1 pint per horse-power per hour, which means that for every 100 horse-power of the engine there is consumed approximately 300 gallons per day. With a 15-knot boat the passage from Havre to New York might be expected to occupy from twelve to fifteen days. Hence for every 100 horse-power of the engine it will be necessary to carry 4,500 gallons of fuel, occupying approximately 723 cubic feet of space and weighing 15 tons, or more, if fuels heavier and less efficient than petrol be employed. To complete the absurdity, the Calais-Dover racer would require, to enable it to cross the Atlantic, a bulk of petrol of greater weight and greater displacement than the boat itself. Seemingly nothing smaller than a torpedo-boat destroyer could attempt to fulfill the conditions laid down, and for a vessel of these dimensions an engine of 500 horse-power would not be excessive."

The 4,000-mile "reliability trial" of a motor-car which has been made under supervision of the British Automobile Club was brought to a successful conclusion on December 7, 1904. The trial was undertaken by Capt. Deasy in a 16 to 20-horse-power Martini car fitted with Dunlop tires and weighing empty 23¾ hundredweight. A distance of 4,002 miles was covered under ordinary touring conditions, and under the continuous observation of officials appointed by the club. The daily run consisted of a maximum of 200 miles a day on main roads, starting from and returning to the Automobile Club. The number of days occupied was 22, the total gasoline consumption 245¼ gallons, the total consumption of water 3.9 gallons, the average daily mileage 181.8, the average mileage per gallon of fuel 16.3, and the average mileage per gallon of water 1,015. The roads throughout the trial were somewhat heavy and greasy, and there was much fog. Rain and snow and numbers of loose patches of stones were encountered. On the fourth day a bad side-slip occurred, the near hind wheel hitting the curb hard and slightly displacing the rim. This caused the tire to chafe on the head of the chain bolt. A new wheel and tire were fitted at the end of the day's run. Three other side-slips also occurred. The car was fitted with low-tension magneto-ignition. Considering the state of the weather during which the runs were made, the result is highly creditable to the makers of the car. The test has successfully established the fact that a good motor-car can be thoroughly relied upon for all that it can be reasonably called upon to do, and that it is no more liable to accident or disaster than any other machinery.

Dr. E. S. Banks, field director of the University of Chicago expedition to Babylonia, has reported the discovery of a statue which he regards as the oldest in the world. It was found eight feet beneath the ruins of the ancient city of Udnun, near the present village of Bismya, and has been identified by an inscription as that of King Daddu, of Udnun. The statue is of pure white marble, weighing 200 pounds, and is almost perfect. Udnun is mentioned in the code of Hammurabi, but little is known of it. King Daddu is not mentioned in the earliest records.

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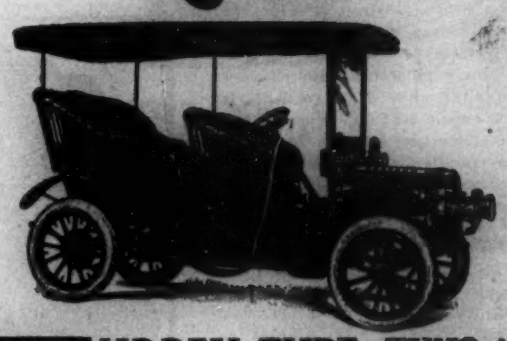
Rambler



SURREY, TYPE TWO has ample power for rough roads and hills; has throttle (speed regulator) attached to steering wheel—one hand can manage both; automatic spark governor; cooling system that makes pumps and fans unnecessary; powerful brakes long wheel base; large wheels and tires; canopy top; water-proof side curtains; plate-glass swinging front; and other marked provisions for *comfort, safety* and *reliability.* $2000, complete with lamps, tools, etc. Other models $750, $850 $1350, $3000

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DURO SENSE

If **you** purchase an automobile **your** money pay for it.

You are the one who walks home if anything goes wrong.

Are **you** the one to be satisfied or the dealer?

If **you** think the dealer is, this Sense is not for you.

If **you** know you are, why not **insist** on the **best** equipment and save future trouble.

Duro Ignition Batteries **are** the best.

The dealer may not be willing to prove this to you for the same old reason, "they cost more."

Every user will prove it.

Or our guarantee does it.

The **Duro** Battery is **Absolutely Guaranteed** against everything except abuse, for one year, 365 days, Sundays included.

And

We want every **Duro** Battery back that does not give **perfect** satisfaction. In return for the battery we will purchase **you** a new battery of such make as you think better.

We **know** the **Duro,** so we can't lose.

A little trouble now by **insisting** will certainly **make you** thankful next summer.

CHICAGO BATTERY COMPANY

Chicago Show, Space No. 305-6 — 1425 Michigan Avenue, Chicago

Chicago Storage Battery Co.

Operated by

Chicago Pneumatic Tool Co.

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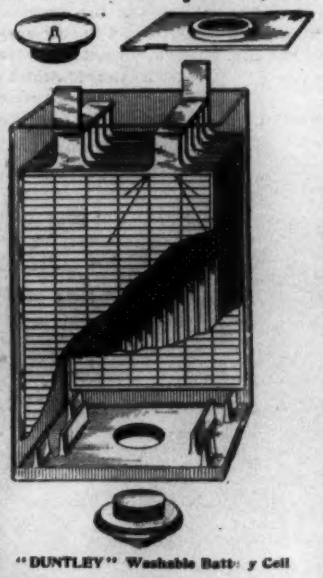
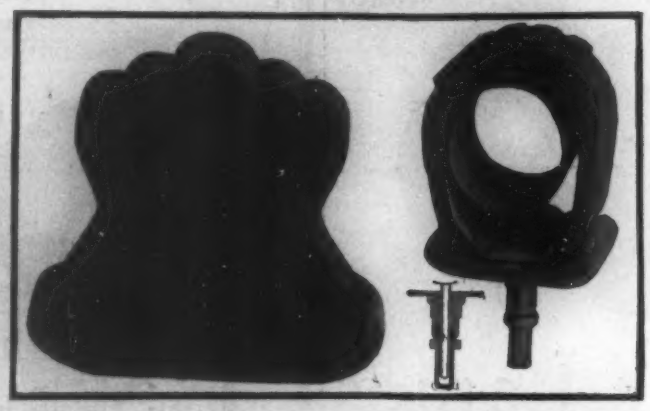
Manufacturers and Sole owners of the "DUNTLEY" Washable Battery Cell, the only Cell in existence which enables the cleansing of cells in a few minutes by a novice. This single feature and consequent saving effected in time consumed in cleaning, alone makes comparison between other types of battery cells and the "DUNTLEY" impracticable. We manufacture the "LITTLE GIANT" Accumulator Batteries for Automobile, Gas and Gasoline Engine ignition; the only igniting battery on the market with liquid electrolyte that will not slop over or spill even though turned upside-down. Batteries for TRAIN LIGHTING and Igniting Purposes our specialty, but manufacture batteries for every purpose. SEE EXHIBIT NEW YORK AND CHICAGO AUTOMOBILE SHOWS.



"DUNTLEY" Washable Battery Cell

SOLID AND NON-SKID TIRES FOR AUTOMOBILES.

The accompanying illustration is a cross-section of a solid cushion tire that has received a thorough test during the past year, and has shown itself to have numerous advantages. The Swinehart solid clincher tire can be used on any wheel fitted with the standard clincher rim. The concave sides of the tire, the inventor has found, give it a considerable increase of resiliency over the ordinary solid tire, while the large rounded rib in the center of the tread carries practically the whole load on level roads, and, being made of the best grade of rubber, absorbs all the vibration caused by small stones and obstructions. As the tire is now made, the blow received from an obstacle projecting an inch or so above the roadbed is practically all absorbed in the tire. Those who have used this tire claim that it rides as easy as a pneumatic, is faster (which has been demonstrated by tests on electric vehicles), and is of necessity much more durable, besides the constant dread of a puncture being eliminated. A car fitted with these tires was driven in the New York-St. Louis run last summer, and the driver claims he was able to drive for miles through sand on the high gear, where the cars fitted with pneumatics had to go on their intermediate or low gears on account of the increased resistance. A solid tire will likewise cut through mud and find bottom, on which it rolls with less resistance and without withdrawing a lot of the soil, as does a pneumatic, especially when the earth is of a clayey nature. The cost of this new tire is no more than that of a good pneumatic, and for any ordinary touring car it will save much annoyance and expense.



SWINEHART SOLID CLINCHER TIRE AND GOODRICH DETACHABLE NON-SKID TIRE WITH TWO-PIECE UNITED LUG.

About a year ago there was a great agitation on the Continent regarding tires and tire protectors for the prevention of skidding. A test of these various devices was made in France, and the result was duly reported in our columns. Descriptions of some of the non-skidding tires were published in the June 25, 1904, issue of this journal, and also in SUPPLEMENT No. 1474.

An American device of this character, which is being made by some of the leading tire companies, such as the Goodrich, the Diamond, and the Fisk, is illustrated herewith. The Bailey "Won't Slip" tire has found favor wherever used. Owing to the raised buttons on the tread, it will not slip or skid on slippery asphalt or greasy roads. Nor is there any loss of power from slipping wheels. A new type of double bronze nut and lock nut, shown in cross-section in the illustration, is used for securing the lugs on the Goodrich tires. Being made of brass, these nuts will not rust and be difficult of removal. Furthermore, as the inner end of the lock nut is larger than the hole in the first nut, through which the lock nut stem is passed, it cannot separate from the nut proper and become lost, although it can be unscrewed separately.

A typical non-skidding tire built on the lines of most French tires of this kind is made by the Republic Rubber Shoe and Tire Company, of this city. The tire has vulcanized to it a leather band filled with steel rivets that stop all skidding and protect the tire.

TIMING AUTOMOBILE RACES.

Timing an automobile race is no simple task. Cars that are traveling at the rate of 80 and 90 miles an hour cover a long distance in a second. Even a fifth of a second represents a distance of from 20 to 25 feet, so that in comparing the records of two machines, the slightest error in timing might place two cars on an equal footing which, had they raced together, would have been separated by a considerable space. Now, since even the most experienced of timers are apt to vary somewhat in the timing of a race, an error of a fifth of a second being of frequent occurrence, it is not strange that the inexperienced men usually called upon to time automobile races should record variations of an entire second or more. The need of an automatic errorless timing system is thus plainly made apparent. Such a system called the Mors system was recently described in these columns. This apparatus, however, possesses the fault of being rather too complicated for an unskilled man to understand and operate. We illustrate herewith a simpler system invented by Mr. Alden L. McMurtry, of this city. This system was used recently in modified form at the hill-climbing contest at Eagle Rock. It is also being used during the present week at Ormond Beach, Florida.

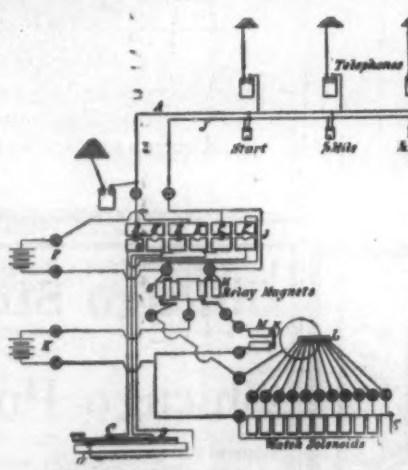


DIAGRAM OF THE ELECTRIC CIRCUITS.

Briefly, the system comprises a line circuit running along the course, which is closed by automobiles in passing over wires stretched across the course, at the start, quarter mile, half mile, kilometer, etc., or at any other intervals required. The impulse sent over the line on closing the circuit operates, through a relay circuit, a series of stop watches at the main timing station. At the start all the watches are set running, and thereafter, under the control of a "distributor," the watches are successively stopped as the different timing points of the course are reached by the machines. The distributor consists of a metal arm adapted to be moved over a distributor plate provided with radially-disposed rows of perforations. Contact pins are fitted into these perforations in any desired combination, and the rows of pins are successively engaged by contact fingers projecting from the distributor arm. Each contact pin of a row has electrical connection with a solenoid, which operates one of the stop watches, so that as the distributor arm is moved around by the closing of the line circuit at the timing stations, the different watches will be started and stopped according to the positions of the pins in the distributor plate.

With this brief outline of the system in mind, we may proceed to a more detailed description of the operations. The wire at each timing station is stretched at the proper tension across the course, and held down by chains to within a few inches of the ground. One end of the wire is fixed, while the other end is attached to a latch which holds open a switch. When a car in passing over the wire trips the latch, the switch is closed by action of the spring, and at the same time a time-switch is set in operation, which opens the circuit again a moment later. The switch may then be reset if it is desired to time a second car at that station. When the circuit is closed, the course of the current may be traced along wire, *A*, through switch, *B*, strap, *C*, key, *D*, switch, *E*, to the battery, *F*, thence through relay magnets, *G* and *H*, along line wire, *J*, back to the timing station. When the relay magnets are energized, two circuits of battery, *K*, are closed; one by the armature of magnet, *G*, conveying current to the distributor arm, *L*, whence it passes through whatever pins it may be in contact with, to the corresponding watch solenoids, and back to the battery. The armature of each watch solenoid is connected with a spring plunger, which strikes the stem of a corresponding stop watch. The other circuit, closed by the armature of magnet, *H*, serves to energize the distributor magnet, *M*. The armature, *N*, of this magnet, when drawn forward, sets an escapement device connected with the distributor arm. When the line current is broken by the time switch above referred to, the relay circuits are also broken, releasing the armature, *N*, operating the escapement device, and causing the distributor to swing about over the next radial row of pins. The operation is then repeated, when the wire at the next timing station is crossed, and so on, until the finish of the course is reached. Before the start the distributor may be moved about to the desired position, and all the watches set by depressing the key, *D*, which governs the relay circuits in the same manner as do the switches at the timing stations. The circuit closed by this key may be traced through switch, *E*, battery, *F*, magnets, *G* and *H*, wire, *J*, switch, *P*, and contact point, *O*, of the key.

The arrangement of the pins on the distributor plate is preferably as follows: In the first two rows the outer pin only is inserted. This energizes the solenoid *S*, when the key is depressed, and this solenoid is arranged to operate all the watches at once. Thus, the watches were all set at the start of the race. When the starting line is crossed, the same solenoid is actuated through the pin in the second radial row, striking all the watches again and starting them. If desired, the solenoid, *S*, may be discarded and two complete rows of pins used instead, which will, of course, produce the same effect. The third row will contain a pin in the second perforation of the row only, so that when the first timing station is reached, the first watch solenoid only will be energized, and the corresponding watch will be stopped. The fourth row will contain a pin in the third perforation only, operating the second watch, etc. Each timing station is provided with a telephone, through which communication may be had with the main station. By this means the operator learns the number of the car which makes the time registered by the watch, and can mark this down on the record sheet. Preferably, the foremost car only is timed at the intermediate stations, but at the finish the records of the second and third cars are also taken.

To prevent fraud, the apparatus may be installed at each end of the line, giving a duplicate record. The apparatus is also so arranged that by opening switches, *B*, *E*, and *P*, and closing switches *B'*, *E'*, and *P'*, the system may be converted from an open circuit to a closed idle-circuit system. Batteries would then be installed at each timing station, and cut into the circuit by the cars when crossing the line. This would render it difficult for an unauthorized person to send false signals over the line by meddling with the wires. This system may also

(*Continued on page 80.*)

IMPROVED APPARATUS FOR TIMING AUTOMOBILE RACES.

A MODIFIED FORM OF THE TIMING APPARATUS.

The Royal Tourist True Blue

32-38 H. P. 2,500 lbs.

$3,000.00

Double the Satisfaction at one-half the expense

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For 1905 we have the FORD MODEL "B" with a four-cylinder (vertical) engine, extra long wheel base, side entrance tonneau, direct drive, and an absolutely new and original idea in driving construction. Weight is 1700 lbs., and as the engine develops more than 30 H. P., it gives the car more power for its weight than any Automobile of similar type.

The Ford driving frame is such an evident advance in construction that everyone interested ought to have our new catalogue describing this wonderful Ford invention. Price of Model "B" $2000.

FORD MODEL B, PRICE $2000

FORD MODEL C, PRICE $800

The FORD MODEL "C" has a 10 H. P., double opposed motor with the successful Ford planetary transmission, a lengthened wheel base and perfect distribution of weight, making it the most practical car on the market for business or professional men or for ordinary family use. The price of Model "C" is $650, with detachable tonneau, so the car can be used as a runabout if desired.

Economy of maintenance, always a feature of the Ford cars, is further guaranteed in the 1905 Models, by light, strong construction and mechanical simplicity and excellence.

Catalogue sent on request.

FORD MOTOR COMPANY, - - DETROIT, MICH.

Canadian Trade supplied by Ford Motor Co. of Canada, Ltd., Walkerville, Ont.

By Every Test the Fisk is Best

Fisk "Heavy-Car" type can renew the tread, can take it off the rim without bars, can't pinch the tube, can get more miles than other tire.

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LOS ANGELES, 1034 So. Main St.

MONTREAL, CANADA. LONDON, ENGLAND.

THE STOLZE GAS TURBINE.

BY DR. ALFRED GRADENWITZ.

The steady progress made by steam turbines on the one hand and the ever-increasing use of reciprocating gas motors in cases where steam engines were formerly exclusively used, lend particular interest to a gas turbine that has been introduced in Germany.

The gas turbine in question is, strange to say, of no recent date. In fact, it was invented by Dr. Stolze as far back as 1873.

We are indebted to the courtesy of the Gasturbinen Gesellschaft Stolze, of Berlin-Charlottenburg, for the particulars given below, as well as for the illustration reproduced.

The principle underlying the construction of this turbine consists in compressing atmospheric air to a moderate tension, say one and one-half atmospheres above atmospheric pressure, and in heating afterward this compressed air so as to cause it to assume a two or two and one-half fold volume, with the same tension, after which the air tension is allowed to drop again to atmospheric pressure.

The excess of work performed over the absorbed energy is thus due to the increase in volume resulting from the heating.

Two sets of turbines of different design are mounted on a common shaft. One of these serves as an air compressor, while the other drives the shaft by means of the heated air. Each set consists of several rows of guiding vanes, fitted to the engine casing, and of several rows of running vanes of a corresponding design, secured to a common rotating cone, which turns with the shaft. One of these turbine systems draws in the fresh air, compressing it to a given tension through a preheater (heated with exhaust gases) and driving the greater part of it into a chamber lined with refractory material. The smaller part is conveyed beneath the grate of a producer, where it serves to volatilize the fuel. The gas thus formed penetrates into the chamber mentioned, to be burnt there by the compressed air in suitable burners and converted into carbonic acid and water vapor, while evolving large amounts of heat. These gases next enter the second turbine system, where they are allowed to expand in traversing the various steps, thus performing useful work.

The process is thus analogous to the cycle performed in all combustion engines. A distinguishing feature is, however, that the mixing takes place after compression, and the combustion at constant pressure.

A large-sized engine of an output of 200 effective horse-power is nearing completion in Berlin, and this plant is represented in the accompanying photograph.

THE STOLZE GAS TURBINE.

THE OLD PORTAGE RAILROAD IN PENNSYLVANIA.

BY EDWARD H. L. PAGE.

The recently constructed freight cutoff of the Pennsylvania Railroad Company south of Altoona, Pa., for the purpose of relieving the greatly congested freight traffic of that city, has destroyed some of the historic old landmarks of the State, and suggests at this time a sketch of the evolution of transportation during the nineteenth century in the Keystone State.

For some time prior to 1800, travel across the State had been made in canoes, and in river barges propelled by poles, or along the shores of her ever-winding rivers by horse and foot, and by intervening portages on Indian trails, connecting points on the different rivers. Thus at this time was made the disastrous expedition of the British, under the leadership of the foolhardy Gen. Braddock, for the purpose of driving the French and Indians from Fort Duquesne, in the western extremity of the State. Several years after the States had gained their independence, the merging of Fort Duquesne into the settlement of Pittsburg suggested to the national government the advisability of an improved method of communication with this distributing point.

Accordingly, the Philadelphia-Pittsburg national pike was built upon such a substantial basis, that wherever undisturbed, as in the central part of the State, by the encroachment of "modern improvements," we still find the gracefully-modeled arches of solid masonry almost intact, after more than a century has passed. The completion of the Old Portage Railroad, by the State of Pennsylvania in 1834, put an end to the time-honored "coach and six," with the many picturesque and commodious inns and taverns, along the line of this broad macadamized toll road; which in its substantial construction was, in point of endurance, second only to the grand old Roman military roads of Great Britain. In 1834 the old Portage Railroad was built from Hollidaysburg to Johnstown, over the Allegheny Mountains, a distance of forty miles, to connect the canals which traversed the State east and west from these points.

The Old Portage Road was constructed from material brought from England. The British government sent over experienced engineers to instruct the Americans in the running of the stationary steam engines used upon the inclined planes of the road. The railroad's highest point was about twenty-seven hundred feet above sea level; being only two hundred feet lower than the neighboring hill, which is the highest point of the Allegheny Mountains in Pennsylvania. The road consisted of ten planes, five of which were on either side of the mountain, and intervening levels. In 1835 the canalboats were so constructed that they could be taken in sections and hauled over the mountain on flat cars, without disturbing their cargoes.

The road was governed by a board known as canal commissioners, who were elected by popular vote. The canal commissioners had entire charge of the maintenance of the canals and the Portage Road.

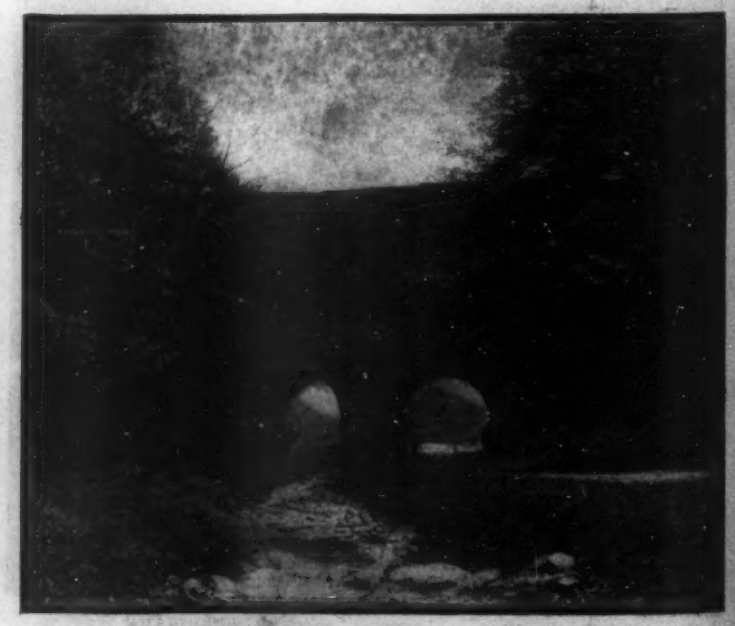
A superintendent was elected from among their number, to have especial authority over the railroad.

The rails of the road were of iron, weighing about twenty-five pounds to the foot, and were secured to stone sleepers twenty inches square, which were sunk in the ground in parallel rows. The width between the rails was about six feet. Until some twenty-five years ago, stone sleepers were in use upon the New York, New Haven & Hartford Railway, and were then removed on account of the especial wear and tear upon the rolling stock, which was avoided in the use of the more resilient, modern wooden tie. Few of the stone sleepers to-day remain embedded in their old resting places, most of them having been removed, recut, and utilized in the construction of public buildings in the nearby county seats. In this era of railway construction the modern iron and steel bridges were unknown. The crossing of streams and the national pikes was done by the construction of the substantial stone arches and culverts.

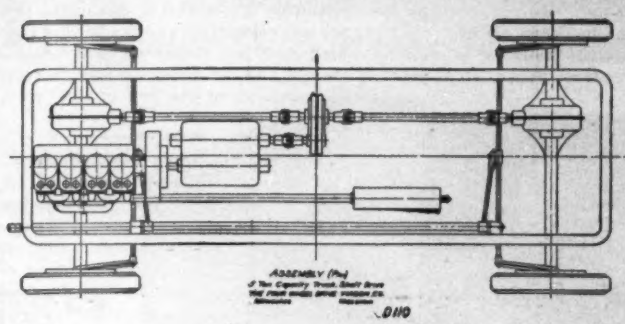
In 1845 to 1855 the construction of railway locomotives had reached such a stage of perfection, that it permitted the building of railroads ascending the mountain, by gradualy graded routes, entirely dispensing with the necessity of inclined planes with their stationary engines. And so the "New Portage" Railroad was built by the State, and contemporaneously, beginning in 1846, a company of private individuals, known as the Pennsylvania Railroad Company, was formed, stock issued, and the road laid along its present route. In 1854, after the rival lines had run for about two years, the Pennsylvania Railroad Company bought the New Portage Road from the State. Com-

Photograph copyrighted 1903 by H. H. L. Page.

SECTION OF OLD PORTAGE ROADBED, SHOWING DOUBLE ROWS OF STONE SLEEPERS.



MASSIVE STONE CULVERT, RECENTLY DESTROYED. ERECTED IN 1846 ON THE LINE OF THE NEW PORTAGE RAILROAD.



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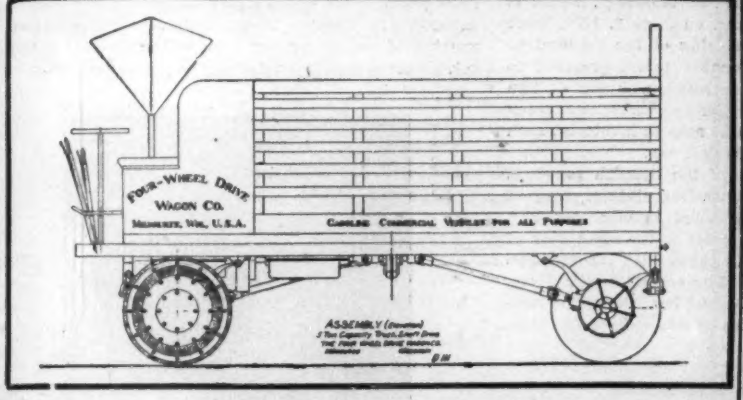

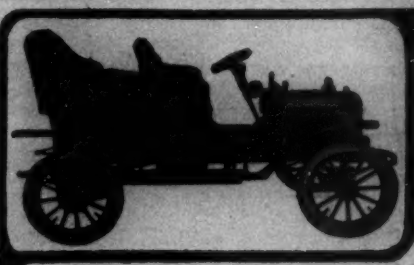

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mon rumor says that at this time the State Legislature was "greased," and that not a cent of the $47,000,000 which was to have been paid for the road was ever received into the treasury of Pennsylvania; or as one visitor to this historic point writes: "Only another instance, by the way, to show the politicians of the present day are simply encroaching upon the methods of those of olden times." Immediately following the charge of bribery upon the part of the railroad company, Pennsylvania turned from a Democratic into a Whig State.

The best time made on the Old Portage Road for the forty miles between Hollidaysburg and Johnstown was twelve hours. Express trains on the Pennsylvania Railroad now run a similar parallel distance over the Allegheny Mountains in a trifle over one hour. The passenger traffic on the road in those days was usually limited to one car each way a day, with a capacity of thirty people. The locomotives, as in the case of those in use in England to-day, had but little protection of the engineer and fireman. The passenger cars were attached to the rear of the train. In descending the planes, an ingeniously constructed two-wheeled safety car was attached in front of the train, and came automatically into service immediately upon the breaking of a cable. An old employé of the road states that serious accidents very rarely occurred. The inclined planes were operated by stationary engines of eighty horse-power each, located at the head of each plane. Double endless cables were used, made at first of hemp, three inches in diameter, and later of iron. In their mode of operation differing from the planes in use in Pittsburg and other hilly cities to-day, the trains on those planes were each attached upon their arrival to the cable,

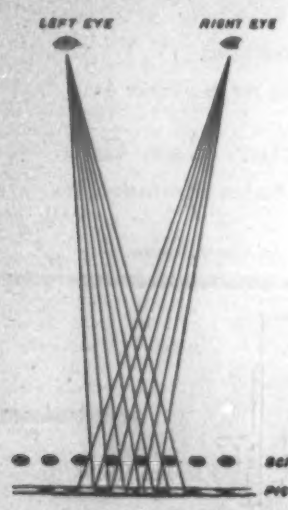


Diagram to Show How One Eye Sees One Series of Stripes While the Other Sees Only the Other Series.

instead of being permanently connected with it. It required the work of an expert "hitcher" to attach the train with the cable by a short cable of great strength. The weight of the descending train was used to balance that of the one ascending, on double tracks. It is hardly necessary to say, in quoting the words of a present-day passenger conductor, that in the Old Portage days there was no "running through midnight fogs at the terrific speed of 60 to 90 miles per hour." Then ten miles per hour was dreaded as "dangerous speed."

Many of the culverts along the line of the Old Portage Road were not built with the keystone for strength, as at the present day; but following the method of construction of the period, about 1830, were built with the rows of stones running in a spiral form to give the required strength. In the photograph of the double stone culvert on the line of the New Portage Railroad, built in 1848, it will be seen that the more modern keystone method of constructing stone arches is employed.

The Scientific American en Route.

Regular readers of the Scientific American will be gratified to note that some fifty express trains arriving or leaving New York daily carry the Scientific American in the library or smoking cars. It will be found on the trains of the New York Central and Hudson River Railroad, the Lake Shore Railroad, the "Big Four" Railroad, the Michigan Central Railroad, the Delaware, Lackawanna and Western Railroad, and the New York, New Haven and Hartford Railroad. The Scientific American will also be found on seventy-five of the transatlantic and coastwise steamers, so that its regular readers will find it *en route*.

A PAVEMENT OF WHALES' BONES.

BY ARTHUR INKERSLEY.

One of the most picturesque towns in California or on the Pacific Slope is Monterey. Historically, it is the most interesting town in the Western States. It

A PAVEMENT OF THE VERTEBRÆ AND BONES OF WHALES.

was the capital of Alta California when the Spanish held sway, in the days "before the Gringo came." Father Junipero Serra landed at Monterey, which is on the bay of the same name, on June 3, 1770, more than six years before the signing of the Declaration of Independence. The missionary priest preached to the Indians and founded the mission church of San Carlos, which is still in excellent preservation. Many relics of Spanish rule are to be seen in Monterey, such as the old custom house, the jail, etc.

Besides being the capital of the Spanish province, Monterey was an important whaling station, many of those great mammals being found in Monterey Bay. The walk leading from the street to the main door of San Carlos mission church is paved with the vertebræ and other bones of whales. The accompanying photograph, made at the end of August last, shows the composition and present condition of this remarkable pavement.

THE PARALLAX STEREOGRAM.

An interesting method of obtaining a stereoscopic effect by means of a lined screen is that known under the above title. By means of this invention, which we owe to Mr. F. Ives, the subject appears to stand out in high relief. The general principles involved are these:

Two photographs are first obtained by twin stereoscopic lenses, in the usual way, but interposed between the subject and the lenses is a screen of fine parallel lines. These lines are spaced by distances equal to their thickness, one-hundredth of an inch. Consequently, the negatives consist of a series of stripes, or rather of a number of long, excessively narrow photographs separated by blank spaces of exactly the same dimensions.

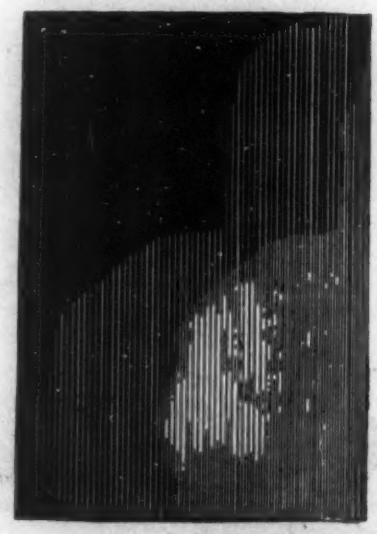
The negatives are now superposed so that the stripes left blank on one exactly coincide with the stripes of the other containing the picture. As can be seen from the accompanying illustration, the result is anything but beautiful. The screen and picture, properly spaced, are mounted in a frame, which when held up to the light produces a most excellent stereoscopic effect. As the illustration shows, this is due to the fact that the right eye sees one picture and the left eye the other, corresponding one. But these two images are superposed by the eye, and the result is a view in relief, due to the angularity of the lines of sight from both eyes.

COMPOSITE PICTURE OF TWO STEREOSCOPIC VIEWS, EACH COVERING ALTERNATE STRIPES.

The Number of the Nebulæ.

Prof. Keeler, soon after beginning his programme of work with the Crossley reflector, showed that the number of nebulæ is very much greater than had been supposed. He conservatively placed the number within reach of that telescope at one hundred and twenty thousand. His programme comprised the taking of photographs of one hundred and four of the brighter nebulæ and clusters located in all parts of the sky within reach of the telescope, i. e., north of declination —25 deg. The recent completion of this programme enables us to revise his estimate.

In fifty-seven of the regions seven hundred and forty-five new nebulæ have been discovered. Almost all of them are very small and faint. The regions in which no new ones were found were, as a rule, those surrounding the clusters and very large nebulæ. There were one hundred and forty-two known nebulæ in these regions, making the total number of nebulæ observed eight hundred and eighty-seven, an average of eight and one-half per region. As it would take sixty-two thousand such photographs to cover the entire sky, the results indicate five hundred thousand as the corresponding number of nebulæ within reach of the Crossley reflector. This assumes that the small portion observed



Portion of Picture (left-hand top corner) Enlarged to Show System of Stripes.

represents fairly the entire sky. It is well known that the nebulæ are much more numerous in some parts of the sky than in others. This is a tendency which, so far as we know, affects large and small nebulæ alike. The fact that a considerable number of other subjects than the nebulæ (presumably non-nebulous regions) are included in the programme, indicates that the portion observed is fairly representative of the whole sky.

Longer exposures, more sensitive plates, and more perfect photographs will undoubtedly reveal some nebulæ which do not now appear and others which are confused with the faint stars. It seems probable, therefore, that the number of the nebulæ will ultimately be found to exceed a million.

The positions of the new nebulæ discovered on the Crossley photographs have been determined, and a catalogue of them will be printed in the volume of reproductions of nebulæ and clusters, soon to be issued. C. D. Perrine.

Lick Observatory.

At the station in the southern hemisphere of the Lick Observatory, located at Santiago de Chile, observations have been made during the past year of Alpha Centauri, and an average difference between the radial velocities of the two components is found of about 5.17 kilometers. This may perhaps be due to the relative orbital motion of the two components, and, if so, it would indicate a parallax of 0.76, a combined mass of the components of 1.0 that of the sun; and a mean distance between the two components of 3.46 × 10⁹ kilometers. The parallax thus indicated is almost precisely that resulting from heliometer observations.

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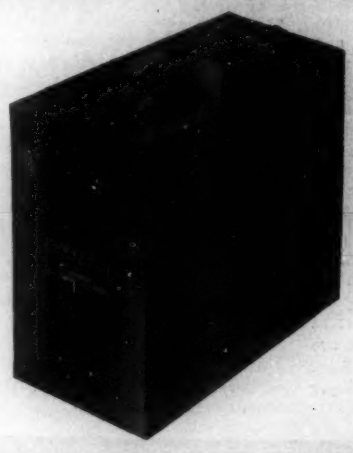

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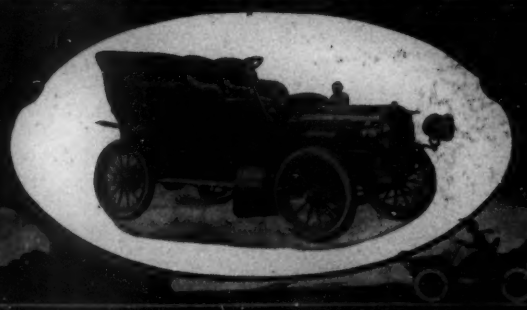

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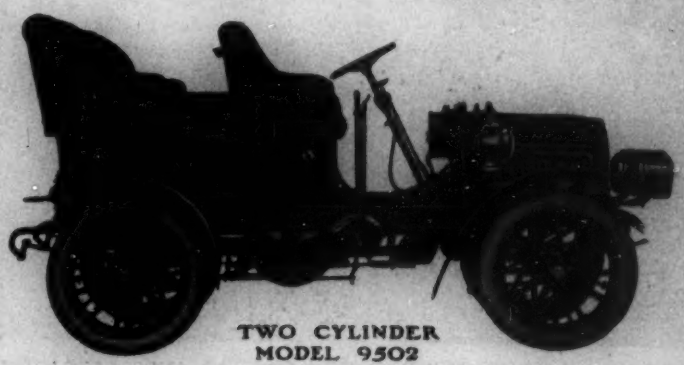

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AGENCIES IN ALL PRINCIPAL CITIES

BANANAS—THEIR CULTURE AND TRANSPORTATION.

BY CHARLES H. HAYWARD.

Thirty-five years ago there were few people in this country who could boast of having seen a bunch of bananas. The fruit was practically unknown; indeed, less was known about it than about the most rare fruits of the tropics at the present day. Now there is no crossroads store so insignificant or so far removed from the usual paths of civilization where it is not a familiar sight. Taking the present rate of importation as 400,000 bunches weekly in round numbers, this being rather below the actual amount than otherwise, and figuring the mean weight of the bunches at 50 pounds, which is also very moderate, 20,000,000 pounds of bananas are now provided for 75,000,000 people every seven days.

Despite the fact that the millions of bunches annually consumed are almost wholly composed of one member of the family—the common guinea—naturalists have recognized and classified as many as forty different varieties, ranging from the *Musa rosacea*, a purely ornamental group that does not develop fruit, to the *Musa enseta*, or giant banana—the *platano* of the Spaniards. From this giant the size decreases more or less gradually until the diminutive "finger" banana is reached, the appellation of which is sufficiently descriptive of its size, but its lack of the latter is more than compensated for by its thin skin and unusual delicacy of flavor. Nor are all the varieties of the same shape; the *arton* and other species grown in the mountains of Central America are perfectly straight and almost as broad as long, and as a result do not lie along the stalk, but stick straight out from it, giving the whole the appearance of a bunch of short stubby spikes. This latter species, as well as the plantain, is most frequently grown in the interior between the rows of coffee trees, for the double purpose of shade and provision, and it is said to be most dangerous to partake of either shortly before or after indulging in spirituous liquor—a fact concerning the banana family of which few outside of the natives and resident physicians are cognizant. Alcohol in certain forms when brought into contact with any kind of banana produces violent fermentation; but it is the firm belief of the natives of the interior, particularly in Costa Rica, that dining on one of these stubby caricatures of the banana with which we are familiar, and topping it off with a dose of *aguardiente*—the native strong water—is productive of fatal results within a few hours.

When a coast native decides to loose his bridled ambition and become a "planter," he selects a spot bordering on some lagoon or river, and with the aid of that universal tool and weapon, the *machete*, supplemented by an unwieldy Spanish ax, he levels brush, trees, and vines for the space of an acre or so, and there they lie until the tropic sun and the trade winds give further vent to his ambition by rendering the pile as dry as tinder. A match completes the task of clearing, and after the embers are cold and the smoke has died away, the ground is ready to receive the suckers, shoots, or settings, as they are variously called according to the locality. It is a matter of common observation that the banana of commerce is absolutely seedless, cultivation through innumerable generations having led to the atrophy of these organs through the substitution of a vegetable method of propagation, much to the advantage of the eater of the fruit at least. Some of the primitive seed-bearing varieties are still said to exist in isolated regions of the Far East. A description of the tree itself is necessary to a proper understanding of the planting operation and its subsequent developments.

The term is a misnomer, as it is not a tree in the ordinary application of the word at all, but a tight roll of leaves which pushes upward, at the same time unfolding the delicate green banners to form its leafy crown. This is quite ornamental at first, but wind and rain soon whip the tender leaves to shreds, leaving but a mass of ribbons to rustle in the trades. The base of a well-grown plant presents a bulb-like appearance, and will carry from one to three or more knoblike excrescences, which are termed "buds" or "eyes." They develop upward first, and after throwing out several leaves, soon grow independent roots, so that they may be severed from the parent plant without injury. These are the "suckers," and form the planter's chief capital. He sets them out in two-foot holes spaced fifteen to eighteen feet apart until his acre or so is covered, and then rests once more to await further developments, which nature is not slow in supplying.

The rapidity of development from the newly-planted sucker to the tree in full bearing is little short of marvelous, and can be appreciated only by one who has witnessed it. Within a space of six or seven weeks the two or three foot plant has more than doubled in size, and a month or so after this the leaves cease to unfold, and a spike appears out of the center of the crown; this is the future stalk of the bunch, and carries a huge red blossom at its end. It develops rapidly, continually bending more and more, until in a short time it has turned completely upon itself, so that the bananas grow end up, or in a position the reverse of which they are usually hung here. At irregular intervals along the entire stalk, and only extending part way round it at any place, the bracts break forth—tiny ridges of flower which are almost immediately replaced by nine to twelve or fifteen embryo bananas. These are the future "hands" of the bunch, so called from their resemblance to that member when held in a certain position, and are separable from the stalk without disturbing their individual components. It is by means of these "hands" that the fruit is classified for shipping. A bunch of nine hands or over, the average being ten to twelve, constitutes a "first"; between seven and nine a "second"; anything under this minimum being discarded by an inspector at the wharf. The writer has seen bunches of seventeen hands, but this abnormal size is equally unfit for shipping, owing to the inconvenience of stowage in the steamer's hold.

After having put forth ten to twelve bracts, the stalk continues to grow and develop the latter. These, however, are sterile, but by a wise provision of nature serve to fertilize their neighbors on other trees through the medium of the humming birds, which abound on the banana farms. When ready for cutting, the stalk and original blossom extend two to three feet beyond the bunch. The spike bearing this gaudy flower appears when the tree has reached a height of ten or twelve feet, but this varies greatly with the locality, unusual fertility of soil, such as is afforded by the alluvial river bottoms, being productive of an abnormal amount of trunk and leaves, but unattended with a corresponding increase in the fruit. The trees in the Matina River district in Costa Rica reach a height of thirty feet or more.

Ten to eleven months after the suckers are placed in the ground the bunches are ready for cutting, and it is here that another peculiar feature of which the banana apparently has a monopoly becomes evident. Practically nine persons out of every ten give expression to the opinion, "How much better a banana must

(Continued on page 80.)

HOW THE NATIVES CARRY THE FRUIT.

CUTTING A BUNCH OF BANANAS WITH THE MACHETE.

TRANSPORTING BANANAS BY MULES. FRUIT STACKED READY FOR THE TRAIN.

LOADING HARD, GREEN BANANAS ON FREIGHT CARS.

Gasoline Automobiles AND Selden Patent

United States Letters Patent No. 549,160, granted to George B. Selden, control broadly all gasoline automobiles which are accepted as commercially practical.

The Commissioner of Patents, in his annual report for 1895, said:

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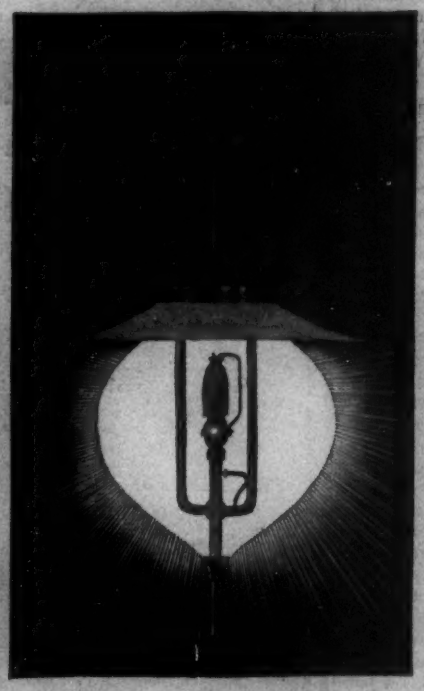

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TIMING AUTOMOBILE RACES.

(*Continued from page 72.*)

be used on a single line wire with ground return. The telephones, owing to their high resistance, as compared to that of the relays, would not interfere with the operation of the system. However, a magneto call could not be used, and in place of it Mr. McMurtry uses a "hummer" call.

At the Eagle Rock hill-climbing contest, the distributor was not used, as it was not found necessary in that style of race. One of our illustrations shows the simple apparatus employed at this race. Our other illustration shows the complete apparatus. The distributor may here be seen at the rear of the board, and the five timing watches are shown in the immediate foreground. The operator with telephone harness applied is seen at the left of the apparatus.

BANANAS.

(*Continued from page 78.*)

taste when allowed to ripen on the tree!" But the contrary is the case, because the fruit will not mature to perfection on the tree; the skins burst, attracting innumerable insects and birds, and the weight of the bunch itself becomes too great for the tree, either one or both coming to the ground. So the bunches are cut when the fruit is half to three-quarters full, i. e., matured, though still green and hard as nails, according to the length of the journey it is to undergo. It continues to feed from the cut stalk, which contains a great amount of sap, until fully ripe, but should the cutting have occurred too soon, while the fruit will turn yellow, it will never attain the flavor or softness or flesh requisite.

With the cutting of the bunch ends the life of the tree, for it bears but once, and is usually cut down to obtain the latter, or succumbs a few days later to the cleaning process, which is merely bringing the spent trees to the ground. A new tree springs from the center of the old stump, and thus there is an everlasting succession without further effort on the part of the planter. Cutting the fruit itself involves the only careful labor on a banana farm, as the bunches weigh fifty to sixty pounds, and even slight knocks are followed by bruised spots, under which the fruit quickly ripens and decays. It is for this reason that land adjacent to a watercourse is most valuable for planting, owing to its accessibility and easy transport by canoe. However, by the liberal use of trash (dried banana leaves) the fruit is safely brought to the railroad on packhorses. Several of the large plantations in Costa Rica have been equipped with complete outfits of light portable railway imported from Germany, this being moved about as the cutting progresses.

At Bluefields the steamer goes up the river and ties up at the farm, moving to the next as soon as the crop is loaded, and so on until a cargo is obtained. But this is one of the few places so favored. At Port Limon, the outlet of the Costa Rican trade, which is of considerable importance, the farms line the railroad for a distance of almost fifty miles, and the bunches are piled along the track, as shown in the accompanying photographs, to await the banana trains. It is not unusual for snakes, tarantulas, and similar unpleasant customers to find a lodging in a bunch of bananas, and when discovered at the loading point, the fact "snake in this car" is usually chalked on the outside, and the carriers handle the bunches very gingerly at the wharf.

At the end of the second year a banana farm is well developed, and there are at least four trees where but one was set out, so that with even a moderately small acreage fruit may be cut practically every week in the year, and the income is continuous. Rotation of crops is unknown, and unless the land be subject to overflow, it is almost valueless at the end of ten years, but many a farmer has become independent before that stage is reached, and the risk of the land giving out seldom causes him much worry. A plantation of forty *manzanas* (about sixty-nine acres) will, after the second year, produce more than fifty thousand bunches annually, and these at the prevailing prices—thirty to fifty cents silver—will be worth between twenty and thirty thousand dollars, or more than double what it usually costs the farmer to buy the land, clear and plant it, and pay the first year's expenses. The cost of running such a farm after the first crop is almost wholly confined to the "cleaning," which does not exceed ten to twelve dollars per acre annually in the majority of banana-growing districts, and considerably less in some.

To the average northerner the banana is but a fruit, seldom eaten in any other manner than raw. To the native of the tropics it is a *multum in parvo*, often his entire sustenance for weeks at a time, his daily bread, and the uses to which he puts it are innumerable. Taken *in toto*, dipped in lye and afterward dried in the sun, it becomes a moldy, shriveled, and most unlovely-looking morsel, but thus prepared it will keep indefinitely, and is instantly ready for use by peeling and baking or boiling, whereupon it expands to two or three times its original size, and forms palatable food. This is a practice of the mountain natives of Nicaragua, and it forms a large part of their diet, supplemented by the inevitable *tortilla*, when on their travels. When almost ripe the fruit is cut into slices and placed in the sun, which causes a certain amount of its sugar to crystallize on the surface; thus prepared it is an excellent conserve. Baked, boiled, or fried in cocoanut oil, it is a staple article of diet the year round, and the last named is quite a delicacy, particularly fried plantains. Banana flour, or rather meal, as it is not ground to the consistency of the former, makes very acceptable cake and bread, and frequent mention is made of its use by the natives by Stanley in "Darkest Africa." The great value of the banana for this purpose is universally appreciated, and numerous attempts have been made to produce banana flour on a commercial basis.

A German firm was said to be about to undertake the production of banana flour, conserves and other similar products, in Nicaragua a few years ago, but whether the project was ever carried out is not known. However, there is little doubt that this will become an actual fact sooner or later. Thus it will be seen that it is only his ignorance of the value of the fruit other than in its raw state, that causes the northerner's lack of appreciation.

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Engineering Notes.

An electric station which will be one of the largest and most modern on the Continent is now being erected just outside of Paris. It will figure among the stations which supply current for the city. A point to be specially noted is the use of steam turbines which drive the dynamos of the station. These turbines are of the type which has been lately brought out by the Swiss firm, Brown, Boveri & Co., and they are now coming into use in different countries, especially for central station use. In the present plant the turbines are designed to use superheated steam at 12 atmospheres pressure, heated to 350 deg. C. The tests show that the turbines consume 15 pounds of steam per kilowatt and per hour, at most. The turbines develop 7,000 horse-power each and are direct-connected with an alternating-current generator mounted on the same base. The speed is 750 revolutions per minute. Each unit thus formed is provided with a surface condenser. The circulation and air-pumps for the latter are operated by electric motors. Lubrication of the working parts is carried out by an oil pump. The alternators are all of the same pattern and deliver three-phase current at 5,000 volts and 25 cycles.

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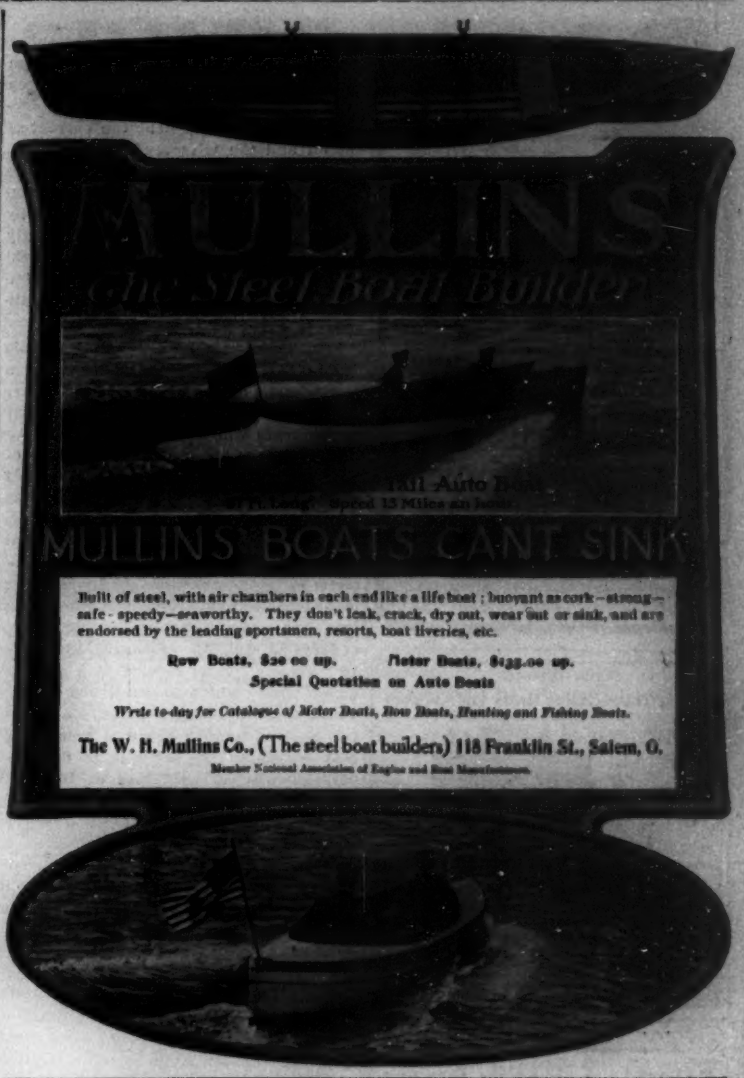
can Concession Syndicate some interesting points were brought out relating to the water power which could be obtained from the Victoria Falls. The total amount of power which the falls can furnish in times of high water is estimated at no less than 35,000,000 horse-power, or five times that of Niagara. If the present plans of the Syndicate are realised, an important industrial center will be developed in the neighborhood of the falls, and they hope to see a flourishing town arise there which will have numerous industries employing electric current generated by the falls. The price of the current would be very low, which will be an inducement for different enterprises, once the hydraulic station is running. According to the first project which the engineers of the company have drawn up for the electric plant, it can be installed at a cost of $250,000 for a total output of 10,000 horse-power. But little energy would be lost in the transportation by overhead lines, on the contrary, to many of the existing hydraulic plants. The Transafrican railroad is now built as far as the falls, so that this will assure a market for the products in South Africa.

An interesting feature of the recently announced developments in Baltimore electric power is the exclusive adoption of steam turbines as the prime mover. A contract recently closed by the Baltimore Electric Power Company with the Westinghouse Machine Company provides an initial equipment of 4,000 kilowatts in two generating units of 2,000 kilowatts each. A Westinghouse electrical equipment, complete and modern in every particular, has also been contracted for. Officers of the company state that the power plant will embody the latest developments in steam and electrical engineering. Being located outside of the congested districts of the city, all the boilers and heavy machinery will be on the ground floor. Floors and roofs will be of steel-concrete construction. The steam turbine plant will operate with a boiler pressure of 175 pounds and a superheat of about 100 deg. F. A high vacuum condensing system will be installed, capable of sustaining a vacuum of 28 pounds at full load on the plant. The plant in its entirety has been designed on the separate unit plan, which virtually consists of a number of distinct power plants placed side by side, each entirely separate from the other, but each capable of helping out the other in case any link in the system should be disabled. This holds good through the entire apparatus, from the coal pile to the customer's building. In addition to this precaution against interruption of service, which is thus insured, the company will install a large storage battery which will ordinarily "float" on the system. The construction work is already under way and will be pushed as rapidly as possible in order that the plan may be complete in all respects and running smoothly by July next.

The Deutz Gas Engine Works have, according to a recent issue of Elektrot. u. Polyt. Rundschau, recently designed a motor locomotive to be driven by internal combustion engines. Experiments so far made have shown such a locomotive not only to be rather suitable for hauling small loads at a moderate speed, especially for mining purposes, but even to possess some special advantages. The engine is the four-cycle type, receiving with each double stroke the required amount of benzine through a small pump driven by the engine, the explosion of the air-benzine mixture being effected by a magneto-electric igniter. The engine turns at 300 revolutions per minute. The locomotive can make as much as 6 kilometers per hour, or 100 meters per minute. The weight of the locomotive, including the cooling water, is about 2,400 kilogrammes. The consumption of fuel is at full load, in the case of benzine or benzol operation, 0.3 to 0.35 kilogramme of benzine or benzol; the corresponding figures being 0.35 to 0.38 kilogramme in the case of alcohol or petroleum operation.



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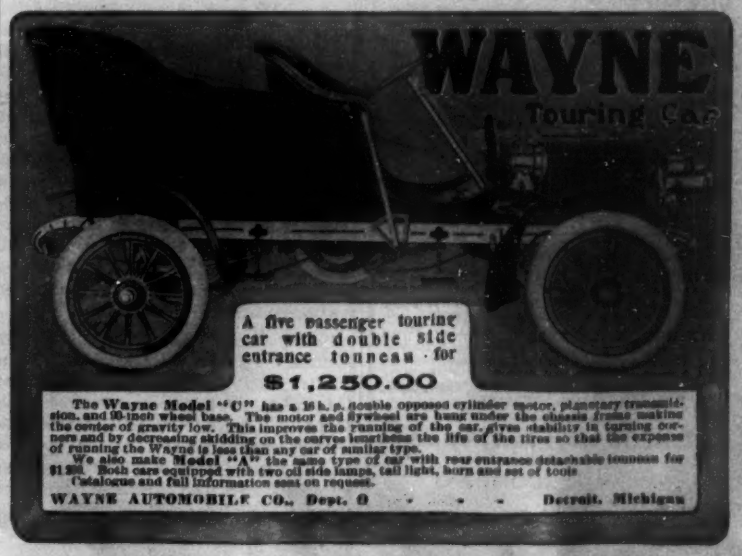

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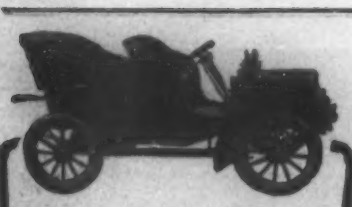

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THE PANAMA CANAL is described from the engineering standpoint in SCIENTIFIC AMERICAN SUPPLEMENT 1339.

WIRELESS TELEGRAPHY. Its Progress and Present Condition are well discussed in SCIENTIFIC AMERICAN SUPPLEMENTS 1423, 1426, 1427, 1536, 1586, 1589, 1583, 1581, 1527, 1534, 1529, 1451.

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Electrical Notes.

A safety device for the protection of persons from the electric current, upon the rupture of a trolley wire, has been placed on the market. By the employment of this arrangement the current is cut off and the wire rendered harmless. The device is fitted to each section of the wire, and consists of an ordinary connecting ear, held in its proper position by the strain on the trolley wire. Directly this tension is released, as by the breaking of the trolley wire, the current is immediately cut off the broken section without any shorting sparks whatever.

In a paper presented to the Academie des Sciences, M. Einthoven describes a new form of sensitive galvanometer which he has devised, together with some experiments which he carried out by applying this very sensitive method of measuring electric currents to the study of the electrical condition of the human body. In the latter case it is especially the electric effects produced by the heart which he observes. The new galvanometer is one of the most sensitive which is known, and at the same time very precise, so that the smallest variations of current can be measured, down to 10^{-10} ampere. It is formed of a silvered quartz fiber which is stretched like a violin cord between the poles of a powerful electro-magnet. When a small current passes in the wire it is deflected perpendicular to the lines of the field and the deflection can be measured directly by means of a microscope carrying a micrometer. The sensitiveness of the instrument can be regulated by adjusting the length of the wire, so that it will measure in the region of 0.001 down to 10^{-11} ampere. The movement of the wire and its variations can be registered by the photographic method. The image of the middle of the cord, magnified 600 diameters, is projected upon a slit which is placed perpendicular to the image. In front of the slit is a cylindrical lens whose axis lies perpendicular to the slit. A photographic plate receives the image which is thus concentrated to a point, and by moving the plate a curve is obtained which corresponds to the current variations. The image of a scale is projected on the plate at the same time in order to measure the curves. The new instrument allows of making measurements which could only be observed heretofore with the electrometer. One of these is the study of radium, which is now made with a gold-leaf electrometer. It will prove especially useful in physiological work. The electric action of the human heart has been observed heretofore with the Lippmann electro-capillary instrument. The muscular shocks of the heart-beats are known to produce variations in the electric potential of the organism, and this was brought out by Waller in 1899. The currents are registered with the Lippmann instrument, but this has many disadvantages, owing to the inertia in the oscillations of the mercury column. The present instrument is more sensitive and works more quickly, as the light quarts fiber, in spite of its length, has but little inertia and can register the variations of current more exactly, and again, the displacement is proportional to the current. M. Einthoven has obtained a series of curves in the shape of regular waves which correspond to the heart beats and show how the electrical effect varies. The effect is, in fact, quite considerable and indicates the great variations of electric potential in the different parts of the body which accompany the muscular shock of the heart. The waves he obtains are similar in form to those of the Marey cardiograph register.

In a series of experiments made by Jeantaud with an electric motor car a tractive effort of 42.7 pounds per ton at 10.8 miles per hour was observed on a dry road. On a very muddy road the tractive effort rose to 74 pounds per ton at 9.32 miles per hour. Thus the resistance on a dry road is 42.3 per cent less than on a muddy road..

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SOME LEADING AUTOMOBILES OF THE PRESENT YEAR.

(*Continued from page 56.*)

driven by a belt from the crankshaft. The inlet valves are automatic on smaller engine, but on the larger one are mechanically operated. All the valves are arranged in the head. The motors are built in two sizes, the one shown having a 3¾-inch bore by a 4¼-inch stroke, and being geared to drive the 1,750-pound car on which it is mounted at a speed of 26 miles an hour at 1,000 R. P. M. The larger motor which is 4½ inches bore by 5½ inches stroke, will drive its 2,400-pound car 37 miles per hour at 1,000 R. P. M. The motor has all the features as regards the adjustability of bearings, etc., that are found on the large water-cooled cars.

The touring car and runabout shown at the bottom of our first page are the product of the Maxwell-Briscoe Automobile Company, of Tarrytown, N. Y. The car itself is largely the invention of Mr. J. D. Maxwell, while the radiator has been particularly designed by Mr. Benjamin Briscoe, who has had a large experience in this line of work. Both the runabout and touring car are fitted with a double opposed-cylinder motor, having the transmission arranged on the extension of the motor crankshaft in a case which forms part of the motor crank case. On the runabout, a two-speed planetary transmission is used, while the sliding gear transmission of the touring car is shown in the cut on page 56. From the transmission a longitudinal driving, or propeller, shaft runs back to the rear axle, which is driven by means of bevel gears. As can be seen from the illustration, the motor is fitted with mechanically-operated valves, integrally-cast heads and cylinders, and a large spoked flywheel. The lower part of the cylinder is cast with radiating flanges, and the cylinders are bolted to the crank case, as shown. The two-to-one cam shaft, seen running across the top of the crank case, carries on its forwardly-projecting end the cam for operating the contact device for the spark. The cam shaft is carried in a frame on top of the crank case, and which can be readily removed. The two water connections, seen on the top of each cylinder valve chamber, go to the top of the radiator, which stands in front of the motor, while the two connections in the bottom of the radiator run to the bottom of the cylinders. The special construction of the radiator, which makes it possible for the water not only to rise rapidly, but to spread in all directions at the same time, allows the inventor to dispense with a pump, which is a considerable simplification. The transmission gear is connected to the motor through a multiple disk clutch, which runs in oil, and consequently wears but very little, while always being able to free itself when the pressure is released. Sliding gears of the usual type give three speeds (with direct drive on the third) and a reverse. The rear axle runs on roller bearings. In case of breakage of the bevel pinion, this can be replaced when on the road with comparatively little trouble. The car weighs complete 1,800 pounds. It has a wheel base of 84 inches, and the 5 x 5 motor is 16 horse-power. The runabout has a 4 x 4 motor, rated at 8 horse-power. The weight of this car complete is about 800 pounds. A feature of the Maxwell car is that the bodies are all made of sheet steel, which, besides being light, is extremely strong, and takes a fine finish.

The steam machine illustrated on our front page is the 1905 product of the White Sewing Machine Company. Besides a lengthened base and more commodious tonneau, the White steamer for this year contains several improvements that add to its ease of operation. The principal of these are a sliding change-speed gear arranged in the same case with the differential, and giving a lower gear for bad roads and hills; and twin water pumps driven from an eccentric on the engine shaft. The supply furnished by one of these pumps is sent back to the tank ordinarily, and when this extra water is needed, it is readily available by opening the small valve seen projecting up at an angle in front of the steering wheel. The same size compound engine employed heretofore is mounted as usual in front, under the bonnet, but because of the new arrangements, it is good for 15 horse-power now instead of 12. The reputation of the White car both here and abroad for speed, reliability, and power, is of the highest. The combination found in it of a compound engine with a flash boiler makes it both economical and easy to operate.

One of the new light-weight touring cars of the double opposed-cylinder type to be brought out this year is the Reo car, shown on our front page. This car was designed by Mr. R. E. Olds, a gas-engine builder of great experience and the originator of the Oldsmobile runabout. While making the car as light as possible, Mr. Olds has at the same time equipped it with a powerful motor, giving 16 brake horse-power at a normal speed of about 900 revolutions per minute. The car complete weighs 1,500 pounds, so that the proportion of horse-power to weight is exceedingly advantageous. The cylinders of the Reo motor are cast integral with the valve chambers on top, thus making the valves readily accessible and placing them and the spark plug where the oil does not collect. The transmission is of the planetary type, and has several improvements, such as a ball-bearing thrust collar, and a plate friction clutch. The motor has a 4¾-inch bore by a 6-inch stroke. This long stroke is said to be especially advantageous for hill-climbing. The water is circulated by a gear-driven pump through a special form of flat-tube radiator which is not injured by freezing. The bearings of the motor are readily removable and have ample wearing surfaces. The brakes are double-acting on the rear wheels and on the driving sprocket. A heavy chain is used and the car is fitted with roller bearings on the front wheels and rear axle. All the mechanical parts are steel drop forgings, bronze bushed. No cast iron is used except in the engine. A pressed-steel frame, tubular axles, and full elliptic springs are other features of the car. While this machine is new there is every reason to believe that it will prove itself to be one of the finest light-weight touring cars for 1905.

New Uses of Electricity.

Almost every day reports of new applications of electricity come to hand. Some of these are very amusing, because they are quite improbable. Others are equally amusing, due to the fact that while the word "electricity" figures in the headline, its use in the application described is merely as a source of power, and therefore bears no particular significance. A report of the latter kind describes an electric process for milking cows, which is said to be cleaner and quicker than the present method of hand-milking. Sifted to the bottom, the electricity figures in this new and wonderful process only as a means of driving a pump; and, while we are not ready to admit that any other power could be applied quite as well here, we can not deny that a four-footed dog could do the work approximately as well as a three-phase motor.

Another report describes what was, in effect, an electric boot-jack. A young man thoughtlessly rested his foot on a wire fence during a thunderstorm. Lightning struck the fence and removed the shoe from his foot. From the report it does not appear that he was much damaged, but the condition of the shoe after the accident is not mentioned. While this is an adaptation of electricity which few would care for, it can not be denied that the lightning did its work, and did it quickly. To suggest the regular use of lightning in this way would be absurd, but it would be no more absurd than are some of the other suggestions which are put forward and received without question.—Electrical Review (N. Y.)

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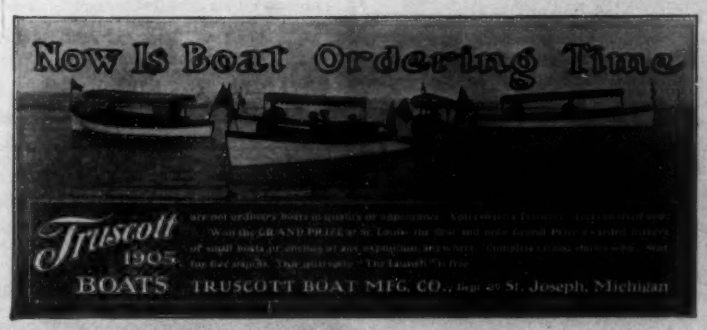

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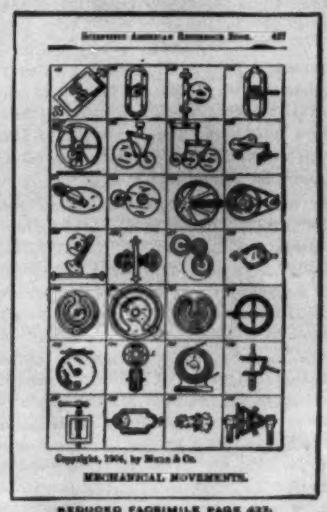
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MECHANICAL MOVEMENTS.

REDUCED FACSIMILE PAGE 427.

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(*Continued from page 57.*)

the coils being visible. This engine has 4½ x 5-inch cylinders, and, at a speed of 900 R. P. M., develops 30 horse-power. Both it and the transmission of the Buffum car are protected by a steel pan beneath. The finish of all the parts of the car is excellent, and the wheels, rear axle, and transmission are all mounted on imported, non-adjustable, ball bearings. The Buffum motor is one of the few American motors having both systems of ignition.

AN AMERICAN MOTOR SLEIGH.

One of the novelties at the recent Automobile Show was a motor sleigh invented by a Boston lawyer, and which has, we are informed, been thoroughly tested and driven at a speed of 15 miles an hour for four hours at a time. As can be seen from the illustrations on page 57, the sleigh body is mounted upon a suitable framework, carrying at the forward end a high-speed, air-cooled, gasoline motor. The first speed reduction is obtained through a large gear meshing with a pinion on the motor. A sprocket on the same shaft as this gear drives a three-throw crankshaft in the middle of the frame by means of a chain running over the large sprocket, *I*, thus reducing the speed still further. The cranks are connected through horizontal connecting rods, *R*, with three pushers, *P*, having at their lower ends spikes and knife blades for cutting into the ice and snow. These pusher rods are hung from slotted arms, which are suitably connected to peculiar-shaped cam disks, *K*, which cause them to rise into the position in which the right-hand pusher is seen in the rear view of the chassis during the return stroke. The pusher rods are provided with springs, which keep them fully extended, yet allow them to be raised in the slots of the arms just mentioned, should they meet with an obstacle in the road. A suitable friction clutch connects the motor to the countershaft when the machine is being driven. The sleigh is provided with two flat grooved plates pivoted on the ends of rods and shown at *BB* in the rear view of the chassis. These plates act as brakes when moved down against the ground. The sleigh is steered by moving the front runners in the same manner as the front wheels are moved on an automobile. The frame of the sleigh is supported on springs on the runners. The principle used for propelling this sleigh is much the same as that used on some of the original locomotives. The inventor claims that it is the correct one, as the pushers pack the snow and obtain a positive hold when traveling in soft snow or on ice. The use of toothed wheels for propelling a motor sleigh, it is claimed, has never been entirely successful. The motor used on the present model is of 4 horse-power. The stroke of the pushers is 16 inches, so that they move the sleigh forward 4 feet for every revolution of the three-throw crankshaft.

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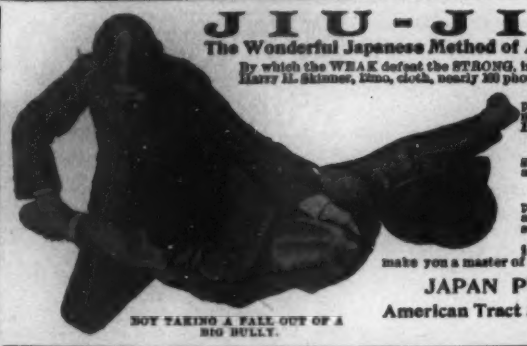

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TYPICAL AMERICAN TOURING CARS FOR 1905.

(*Continued from page 59.*)

erated from a single cam shaft. These valves are interchangeable. The clutch used on this car is of the multiple-disk type. Another of its features is that the engine and transmission are supported upon three points on the main frame, thus making it impossible for them to get out of alignment. This company will continue to make the double opposed-cylinder runabout with individual clutches which has been so successful, and which was described in our Automobile Number last year. In bringing out a touring car, however, the vertical type of motor was adopted as being more in line with current practice.

The Winton Company has abandoned altogether the horizontal motor, and has this year brought out a new four-cylinder touring car having a number of novel features. The car is laid out on the general lines of most four-cylinder cars, having a vertical water-cooled motor with the cylinders cast in pairs. The cylinders are mounted on an aluminium crank case which is split vertically, so that one side may be detached for inspection and adjustment of the crank boxes. This makes it possible to get at the crank-shaft on the side of the car without lying underneath it. A permanent dust pan is attached to the chassis below the motor, which is fitted with adjustable bushings throughout. The inlet chambers are cast in pairs, and bolted to the cylinders with copper-asbestos gaskets. The inlet valve caps may be readily unscrewed by hand. The cap is shown removed in one view of the motor on page 57, which shows in section the end cylinder. The carbureter, C, has a water jacket for keeping it at a uniform temperature. A hand screw, *W*, extending through the dash makes it possible to shut off the gasoline instantly at the carbureter. Jump spark ignition with gear-driven magneto, *M*, and a single non-vibrating coil, which returns the secondary current to a distributer, *D*, on the magneto for distribution to the various spark plugs, *S*, is employed. The contact maker for the primary current is also attached to the magneto. The spark may be varied by a lever attached to the steering column above the steering wheel. The usual Winton individual clutch system, giving two speeds and a reverse with a direct drive on the high gear, is used. The motor and rear axle bearings are all oiled from a common lubricating device, *O*, mounted beside the motor. The oil is picked up by a revolving cylinder, from which it is scraped by a plate beside the cylinder into the various oil tubes that carry it to the bearings. In order to guard against the oil becoming too thick, an auxiliary scraper set at a certain distance from the roller keeps the film at a certain thickness and causes a certain quantity only to flow to the regular scraper, which feeds the ten tubes. The oil is fed in exact proportion to the motor speed. The circulating water is cooled by being pumped through 89 vertical copper tubes 17 inches long and covered with 13-16 inch square radiating fins 3-16 of an inch apart. Both the centrifugal pump, *P*, and the fan behind the radiator are gear-driven. The motor is controlled by throttling the quantity of the mixture. The well-known Winton air governor, acting directly upon plungers, *p*, on the inlet valves, and thus keeping them from opening, is used. The air pressure for this purpose is produced by a gear-driven air pump, *A*, on the front of the engine. The piston of this pump, as well as those of the power cylinders, has a convex head. A diaphragm, *H*, is interposed between the pump and the air pipe, *a*. The priming valve for the carbureter is at *V*. The Winton car has a propeller shaft and live rear axle with bevel gear drive. The transmission gear employed makes it possible to control all the speeds with one pedal and two levers. The 16 to 20-horse-power car weighs 1,800 pounds,

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and is fitted with a four-cylinder vertical motor of 3½ inches bore and 5 inches stroke.

The large Peerless side-entrance tonneau here shown has a 5¾ x 5¾, four-cylinder gasoline motor, which is a duplicate of that on the "Green Dragon" racer which, driven by Barney Oldfield, captured about all the track records last year. This motor is said to develop 60 horse-power. Its main features are an auxiliary exhaust port uncovered by the piston at the end of its working down stroke, the location of the valves in the cylinder head, and both make-and-break and jump spark igniters. A gear-driven magneto furnishes current for the former ignition system, and accumulators and coils for the latter. The transmission of the sliding gear type gives four speeds ahead and reverse. The car has a bevel gear drive. The rear wheels run on ball bearings on the rear axle tube, the divided driving axle within this tube connecting with the outer ends of wheel hubs though jaw clutches. The Peerless Company was the first to use this construction, which has the advantage of relieving the inner axle of all but the driving strains. Other features of the 1905 Peerless car are a special automatic carbureter, pedals having long levers and which push forward instead of down, throttle and spark control in the steering wheel, and both expanding and contracting brakes on the rear wheels, which are 36 inches in diameter, and which in connection with the 107-inch wheel base, make an extremely easy-riding car.

The Ford Motor Company, of Detroit, has this year added to its two-cylinder-opposed-type car the new four-cylinder tonneau shown herewith. This car weighs 1,700 pounds, and is fitted with a 20-horse-power 4¼ x 5-inch engine having copper water jackets, mechanically-operated inlet valves, a force-feed oiler worked by the pressure of the exhaust and feeding oil positively to all four cylinders, and a gear driven circulating pump. The commutator is on top of a vertical shaft driven by spiral gears, and it can readily be got at through a hole in the dash. A planetary transmission giving two speeds and reverse is arranged back of the motor in an open aluminium frame, and is connected through a universal joint with an inclosed propeller shaft running to the rear axle. This is of the live divided type, driven by hardened steel bevel gears and mounted on ball bearings. It is braced by two rods running from the spring perch blocks to the front end of the propeller shaft housing and forming, with the axle, a triangular frame. These two rods take the driving strains off the springs and transmit them to the frame through a large globe universal joint, which supports the front end of the propeller shaft. Expanding ring brakes in the rear-wheel hub drums are operated by a pedal. Another pedal works the reverse, which is also used as a brake if necessary. The low and high speeds are obtained by pulling back or pushing forward the long lever at the side. The throttle and spark are controlled by small handles on the steering column. The Ford is one of the few cars to combine a bevel-gear drive with the well-known American planetary gear, which is simpler to operate, and, it is claimed, is quite as efficient as the usual sliding gear. The motor is sufficiently powerful to drive the car over all ordinary roads on the high gear, upon which the drive is direct, efficient, and economical. A speed of 40 miles an hour is obtainable with it on good roads.

The new 35 to 40-horse-power Columbia machine, fitted with a Royal Victoria tonneau body, having a leather hood over the rear seat, was one of the distinctly new models exhibited at the Automobile Show. Besides the graceful lines in the body, this car has also several improvements in the mechanism proper, one of the most important of which is a new carbureter of the aspirating type, which automatically maintains a correct explosive mixture under all conditions of engine speed and throttle opening without the loss of any power from the operation of a suction-operated auxiliary air valve. The car also contains a new system of spark and throttle control, by means of two levers mounted on a stationary plate within the steering wheel, so that they do not move with the steering wheel, and consequently can be adjusted to a nicety. These levers are connected to the engine through positive ball joints, in which there is no back lash or loss of motion. The pedals that operate the clutch and foot brake are much longer than formerly, and the hand brake and speed-changing levers are held by a new ratchet arrangement. The car is mounted on a pressed-steel frame 5 inches deep, which entirely does away with any warping, and makes the frame particularly strong to carry the new type of side-entrance tonneau body, the footboard and dash of which are permanently attached to the frame. The engine is a four-cylinder vertical one, having a bore and stroke of 5 inches and a normal speed of 800 to 900 R. P. M. The valves are all on the same side of the engine, and mechanically operated. Lubrication of the engine is obtained by means of a mechanical oiler. Jump-spark ignition with two sets of storage batteries is employed. The Whitlock cellular radiator used contains 7 gallons of water, and is backed by a high-speed fan, which aids in the cooling. The car has a four-speed transmission having a direct drive on the high gear. The drive is by countershaft and chains to the rear wheels. Both the foot and hand brake are interlocking with the clutch, which is conical and leather-faced, with provision for greatly reducing the driving effort of the engine before the clutch is released. The car is fitted with irreversible wheel steering, by means of a worm and sector, and having spring-cushion connections to prevent shocks. It is said to be capable of a range of speed of from 8 to 60 miles an hour on the high gear. A wheel base of 108 or 112 inches is used, according to the choice of the purchaser. The Electric Vehicle Company has also continued the manufacture of its double opposed-cylinder 12 to 14-horse-power tonneau, which we illustrated last year, and which won two gold medals in the Mount Washington hill-climbing contest. A new 18-horse-power car of this type, having two 4½ x 5 cylinders and three speeds controlled by a single lever, has also been brought out. This car has a ball governor acting directly on the throttle valve in the carbureter, besides jump-spark ignition by means of current obtained from twenty-five dry cells, arranged in five groups of five cells each, so that they will have an exceedingly long life. The clutch used is formed of expanding bronze shoes, working inside a steel drum. It is run in oil in a compartment at the forward end of the gear box. A bevel-gear drive is used on both of these cars. Besides the gasoline vehicles mentioned, this company also makes its usual line of electric machines.

The Locomobile Company of America has this year brought out four different powered cars, all of which are fitted with a side-entrance tonneau body. These cars are driven by four-cylinder engines, employing made-and-break ignition with current from a magneto. A three-speed transmission is used in all but the 40 to 45-horse-power car, which is fitted with a four-speed sliding gear transmission, has a wheel base of 110 inches, and weighs complete 2,800 pounds. The 15 to 20-horse-power car has a 92-inch wheel base and weighs 2,300 pounds; the 25-horse-power car has a 96-inch wheel base and weighs 2,300 pounds; and the 30 to 35-horse-power car has a 106-inch wheel base and weighs 2,500 pounds. Mechanically operated inlet valves are used on all but the second sized car, which also differs from the others in that it is fitted with jump-spark ignition. This car is practically the same as that turned out by the company last year. The new

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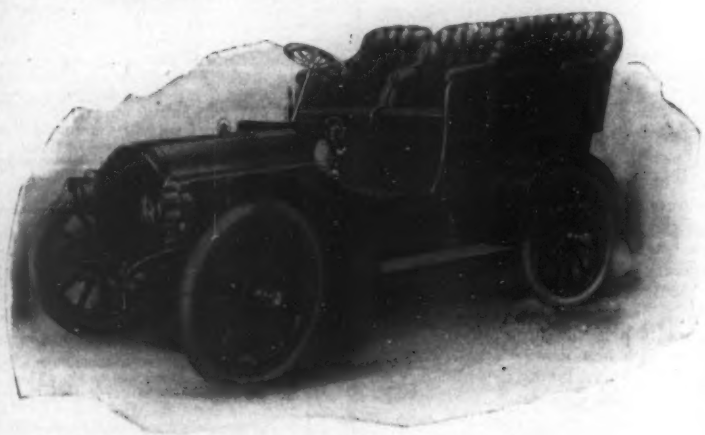

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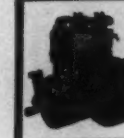

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cars do not differ materially from the model of last year, a chain drive from the countershaft to the rear wheels being used on all of them. A new automatic carbureter is one of the improvements. Simplicity is the keynote of the construction of the Locomobile gasoline machines. This is seen in the fact that plain bearings are used throughout.

The Haynes automobiles exhibited at the recent show are fitted with several novel features. Besides a large 35 to 40-h. p. 4-cylinder touring car, having the usual Haynes individual clutch transmission combined with a new form of bevel gear drive, the usual two-passenger runabout, with an opposed-cylinder motor under the seat, and a new light tonneau with an opposed-cylinder motor placed transversely in front under the bonnet were exhibited. This latter car, which is of 16 to 18 horse power, has all the features of the larger car just mentioned. These consist of a form of roller bevel pinion which operates on a suitably-toothed sprocket arranged on the differential; a vertical stay-bar attached to the differential casing and sliding in a socket on a cross member of the frame, the purpose being to take the thrust from the bevel gear drive off the springs; and a four-pronged slip joint which operates in connection with the rear universal joint near the axle, and allows for the longitudinal motion of the propeller shaft arising from the up-and-down motion of the car body on the springs. Mr. Haynes is one of the oldest automobile builders in America, and in all probability the new features of the Haynes car will be found to give great satisfaction to all users of the same.

The George N. Pierce Company, of Buffalo, N. Y., is one of the leading firms to manufacture a light two-passenger car as well as a large four-cylinder touring car known as the Pierce "Arrow." The small car is fitted with a 6-horse-power, single-cylinder motor of the de Dion type, mounted, together with the transmission, directly on the rear axle. This arrangement removes all vibration of the motor from the body, while at the same time giving a direct drive through spur gears. This light car can be fitted with a stanhope or canopy top with glass front, thus making it usable in all weathers. The Pierce "Arrow" is a large yet light touring car having all modern improvements.

The Elmore Manufacturing Company, of Clyde, Ohio, exhibited the only two-cycle touring car noted at the show. This machine is one of the simplest built, being fitted with a double-cylinder, horizontal motor placed under the seat and driving the rear axle through a chain and planetary gear transmission. It was a car of this type which made two round trips to St. Louis—a distance of 6,000 miles—last summer without the replacement of a single part. One also recently climbed Eagle Rock Hill on the high speed in 2 minutes, 41 seconds—remarkably good time for this 12 per cent mile-long grade.

Another firm that has added to its standard double opposed-cylinder line of touring cars a new model of the four-cylinder vertical type is the Wayne Automobile Company, of Detroit. The new car is a light, high-powered one, having a pressed-steel frame, cellular radiator, and all the usual features of the best cars of this type. The double opposed-cylinder cars are also well-built, powerful machines, capable of giving entire satisfaction under all ordinary conditions of use.

The Waltham Manufacturing Company, makers of the well-known Orient buckboard, have this year brought out four-cylinder 16 and 20 horse-power touring cars of the air-cooled type, in addition to their regular line of runabouts and light cars. The motor of the new car has square flanges cast on the cylinders for radiating the heat. A fan mounted in front maintains the air circulation. The car is one of the neatest of this type that was seen on exhibition. The motor has mechanically-operated inlet valves and a

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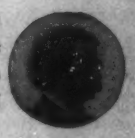

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Inquiry No. 6443.—For manufacturers of wood fiber, insulating washers and bushing and liners.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company Foot of East 138th Street, New York.

Inquiry No. 6444.—For machinery for opening all kinds of nuts, without breaking the meat.

I have every facility for manufacturing and marketing hardware and housefurnishing specialties. Wm. McDonald, 32 Main St., East Rochester, N. Y.

Inquiry No. 6445.—For machinery for making paper barrels.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 45 Canal Street, Chicago.

Inquiry No. 6446.—For a machine for making druggists' small pill boxes.

The SCIENTIFIC AMERICAN SUPPLEMENT is publishing a practical series of illustrated articles on experimental electro-chemistry by *N.* Monroe Hopkins.

Inquiry No. 6447.—For manufacturers of leather, cloth and wood advertising novelties.

WANTED.—Patentees of machines for making concrete brick or blocks. Please send cuts and full description of same to
336 Harrison Street, Richmond, Va.

Inquiry No. 6448.—For manufacturers of domestic calendars and dealers in imported goods.

WANTED.—Revolutionary Documents, Autograph Letters Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C. A. M., Box 773, New York.

Inquiry No. 6449.—For makers of blank leather pocketbooks.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 15 South Canal Street, Chicago.

Inquiry No. 6450.—For manufacturers of steam laundry machinery.

Technical graduate, for five years President of Mechanical and Electrical Mfg., wants to represent an Eastern manufacturer. Have a large and influential acquaintance. W. A. C., 909 New York Life Building, Chicago.

Inquiry No. 6451.—For makers of wooden teeth for use in making patterns for spur gear castings.

CALCULATING MACHINES.—Wanted, first-class firm willing to take up the agency and sale in the United States and Canada of a well-known calculating machine. Terms very favorable. Apply Grimme, Natalis & Co., Brannschweig, Germany.

Inquiry No. 6452.—For manufacturers of recording thermometers.

Cement machine patterns and patents for United States and Canada for sale. Address Box 256, Jackson, Michigan.

Inquiry No. 6453.—For a machine to crack up large crystals to uniform size of about ¼ to ⅜ of an inch.

WANTED.—General Factory Superintendent or Agent. Competent to take charge of large manufacturing plant. All correspondence strictly confidential. Address with full particulars as to experience and qualifications Superintendent, Box 773, New York.

Inquiry No. 6454.—For the present address of the Armat Moving Picture Co.

Inquiry No. 6455.—For parties to manufacture dust pans

Inquiry No. 6456.—For manufacturers of nickel tops for pocket purses.

Inquiry No. 6457.—For the manufacturers of the electrical machine for making puffed rice.

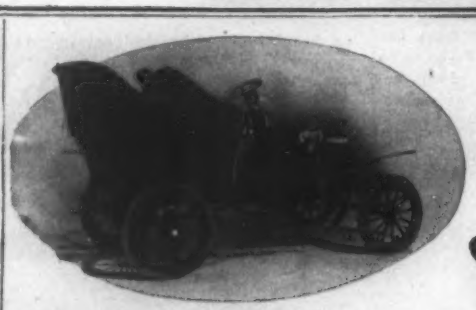
Inquiry No. 6458.—For manufacturers of linden bast combs.

Inquiry No. 6459.—For an apparatus to destroy soft tickets in large quantities.

Inquiry No. 6460.—For manufacturers of table knives, forks and spoons sold under different names, as Australian silver, Mexican silver, etc.

Inquiry No. 6461.—For makers of lead pencils in large quantities, stamped with name and address, for advertising; samples wanted.

Inquiry No. 6462.—For the address of the manufacturer of glass which can be heated red hot and plunged in water without breaking.



The Franklin Light Tonneau

Weight 1,250 pounds; 12 horse-power; four cylinder air-cooled motor.

$1,650

FRANKLIN

The car you want is not the car with the most horse-power, or with this frill or that, but the car that *does the most at the least expense.*

The car you don't want is the complicated heavy car that wears out tires fast, uses gasoline extravagantly, costs a lot for repairs, and is clumsy besides.

The Franklin 12 horse-power Light Tonneau goes faster and better and smoother—on all roads—than most cars of 18 and 20 horse-power. It costs less to buy and less to maintain.

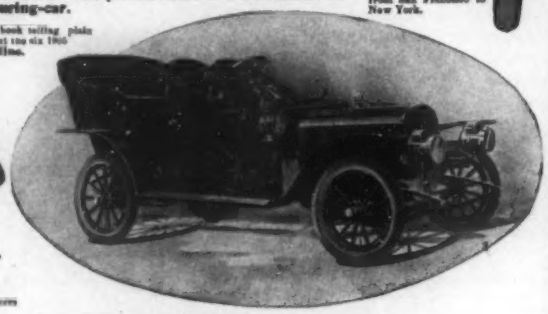
Water-cooled cars get their power by means of heavy motors and complicated parts. The Franklin gets its power by masterly engineering and its light

Four-cylinder Air-cooled Motor

It costs $1,650, not $2,000; but, even at $2,000, it would be cheaper than the others. What does your horse-power cost? What does it do? While you're thinking this over, look up the Franklin and some Franklin owners. The picture below is the **Franklin 20 H. P. Touring-car.**

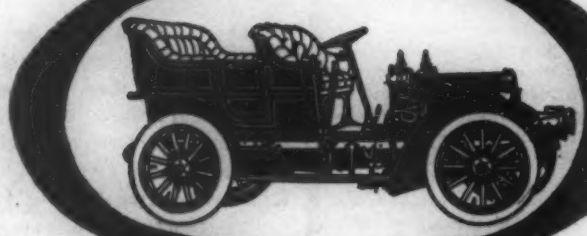
Send for "Coast to Coast" Booklet, story of the Franklin's record from San Francisco to New York.

Send for book telling plain facts about the six 1905 Franklins.



H. H. Franklin Mfg. Co.
Syracuse, N.Y.

Member Association Licensed Automobile Manufacturers



8 Reasons Why

Locomobile

Is Easily the Best Built Car in America

1.—Standard design. No freak features.
2.—Result of long experience on proper lines.
3.—Special material for each part.
4.—All material analyzed and tested.
5.—Forgings used instead of castings.
6.—Every part made interchangeable.
7.—Careful attention given to minute details.
8. Convenience of the customer considered at every point.

1905 MODELS—16-20 h.-p., $2,800; 20-25 h.-p., $3,700; 30-35 h.-p., $5,000; 40-45 h.-p., $7,500.

THE LOCOMOBILE CO., Bridgeport, Conn.

Member Association Licensed Automobile Manufrs.

PACKARD ENAMELED IGNITION CABLE

An entirely new method of making a sure-thing-insulation. Thread wound, tape wound, woven, with intermediate coatings of enamel films and many bakings. Send for booklet "F."

THE PACKARD ELECTRIC COMPANY, Warren, Ohio

three-speed sliding-gear transmission is used.

Two launch-building firms that have taken up the manufacture of automobiles are the Lozier Motor Company, of Plattsburg, N. Y., and the Gas Engine and Power Company, of this city. Both are manufacturing high-grade four-cylinder touring cars of 30 to 35 and 24 horse-power respectively. These cars have all the latest improvements, such as automatic carbureters, mechanically-operated inlet valves, bevel gear drive, etc. The material and workmanship on both leave nothing to be desired.

One of the automobile firms that has profited by road experience with its cars during the past year is the Royal Motor Car Company, of Cleveland, Ohio. The new 30 to 38-horse-power car exhibited by this firm at the show was second to none in general appearance and details of construction. The motor, a 5 x 5½-inch four-cylinder, vertical engine having mechanically operated interchangeable inlet and exhaust valves, is mounted under a bonnet in front in the usual manner. The commutator is located on top of the motor, and is driven by a vertical shaft. The carbureter has an automatic auxiliary air inlet and an intake drawing warm air from a jacket around the exhaust pipe. Positive force feed lubrication is used, and the water is circulated by a gear-driven pump through a radiator of novel construction. The fan is driven by a flat belt having an adjustable pulley. Both the engine and the three-speed transmission are fitted with plain bearings having ring oilers connected with the lubricator. The propeller shaft is of large size and has protected universal joints. The driving gear and pinion are mounted on roller bearings with end-thrust ball bearings. The clutch is of the leather-faced cone type and is connected to the transmission through a universal joint. The brakes are of the expanding ring type both on the driving shaft and the rear wheels. The side-entrance tonneau seats five persons. It has a wheel base of 108 inches, standard tread, and is mounted on 34-inch wheels. The total weight of the car is 2,500 pounds.

The Pope Manufacturing Company, besides its large and powerful Pope-Toledo automobiles, one of which, finished in white, and fitted with a top over the rear seat, attracted much favorable comment at the show, still manufactures its single-cylinder Pope-Hartford model, and has also brought out a new Pope-Hartford machine having a double opposed-cylinder engine, placed transversely in front, and connected to the rear axle through an individual clutch transmission, and a bevel gear drive. This company also manufactures a light two-passenger touring car known as the Pope-Tribune, which has a two-speed-and-reverse sliding gear transmission and bevel gear drive. One of the 90-horse-power Pope-Toledo racers has been entered in the Gordon-Bennett race for this year. One of the main features of the Pope-Toledo car is a copper water jacket, which has been used successfully for several seasons. The transmission of this car, which was illustrated in our Automobile Number last year, has been somewhat modified and improved in the present model. In most respects, however, the 1905 car is quite similar to that built last year.

The Cadillac Automobile Company, of Detroit, Mich., is still another firm to adopt a four-cylinder, vertical motor as the propulsive mechanism of its 1905 touring car. This motor also is fitted with copper water jackets, clamped between a ring on the base of the motor and the cast head. The mechanically operated inlet and exhaust valves are arranged in chambers on one side of the cylinder heads, and the motor is fitted with a governor of a new type consisting of an oil pump which operates a piston connected with the cam shaft of the motor. The volume of oil delivered by the pump

varies with the motor speed. When a sufficient pressure is obtained upon the piston connected with the cam shaft, to move it against the action of a coil spring, it slides the cam shaft lengthways in its bearings and displaces the cams that raise the inlet valves, and which are tapered so as to vary the lift. The consequence is that the valves do not open to their full extent and the motor is throttled. A planetary gear transmission is mounted directly behind the motor and drives the rear axle through a propeller shaft and bevel gears. This transmission is novel in that it gives three speeds forward and one reverse, with a direct drive on the high speed—a very unusual feature for a transmission of this type. The upper half of the differential casing is readily removable, in order to inspect and adjust the differential. Internal expanding ring brakes are used on the rear wheels, which run on ball bearings on the outer axle sleeve, and are driven by a squared-end internal driving shaft. Among the other features of the car are a novel form of flywheel and clutch-releasing mechanism, a new carbureter having no float and which is not affected by tipping in any direction, and a new muffler, designed so as to prevent back pressure.

Among the novelties on exhibition at the show this year was a gasoline lawn-mower—the first of its kind to be built in this country. This mower is manufactured by the Coldwell Lawn Mower Company, of Newburg, N. Y. It is propelled by a two-cycle motor of 4 or 8 horse-power, according to the size of the mower. It will take 10 per cent grades as a maximum, while the steam lawn-mower made by this concern is capable of climbing a 20 per cent grade. The gasoline lawn-mower has but one speed, which is obtained by a friction clutch. A honeycomb radiator mounted in front has a fan behind it which is driven by friction wheels. This fan blows air forward through the radiator, which is necessary to keep the cut grass from flying up in it. The lawn-mower is well built and is sold at a reasonable figure.

Two other novelties seen at the show were speedometers for automobiles which were worked on much the same principle, viz., by means of a gear air pump driven from the wheel and blowing air through a closed circuit of rubber tubing to some sort of an indicating device mounted on the dashboard. One of these, the Webb speedometer, was illustrated in the SCIENTIFIC AMERICAN of Nov. 5. The other one, made by the Wood Speedometer Company, of Boston, indicates the speed upon a gage similar to a steam gage. This company has applied its instrument not only to automobiles, but also to steamboats for indicating the revolutions of the propeller, as well as to the new electric locomotives of the New York Central Railroad, in which the speed is indicated up to a hundred miles an hour. Both instruments are built with great care and are accurate to a remarkable degree.

The improved Morrow coaster brake, manufactured by the Eclipse Machine Company, is adapted for use on motor bicycles, as well as on the foot-propelled machines. This brake consists of an expanding brake sleeve which fits over the central hub carrying the sprocket. The brake sleeve is made the full width of the hub—1¾ inches—and it is 1⅝ inches in diameter. The large friction surface thus secured, as well as the expanding-shoe principle of construction, makes the brake positive and sure to hold under all circumstances. In coasting, all the interior parts of the brake turn around with it, thus doing away with any friction from these parts. The whole hub is then practically a unit revolving on ball bearings.

A new washable storage battery jar has a large screw plug with a rubber washer inserted in a hole in the bottom. By removing the plug and squirting water between the plates, the sediment that has collected in the bottom of the jar can be removed without disturbing the plates.

THE WHITE STEAM CAR

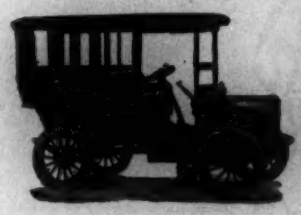
With Limousine Body

The Ideal Closed Automobile

For Shopping and for Evening Use

PRICE

$3,200

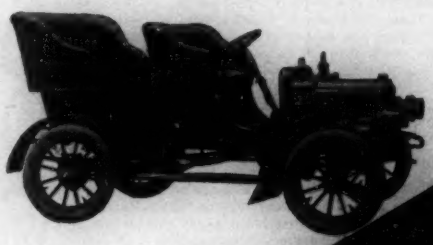


Plenty of Room. Seats Six People. Four Seats Inside. No Noise. NO VIBRATION

The White holds the record of American made cars for the Eagle Rock Hill—1 min., 2⅘ sec.

Send for Particulars

White Sewing Machine Company CLEVELAND OHIO



"Maxwell"

16 H.P. Touring Car
$1,400
New Price

8 H.P. Runabout
$750
New Price

These two automobiles have jumped at a bound into the popular favor of those for whom they were built. The automobilists and the agents of experience who have long been searching for an absolutely dependable car at a moderate price have found in the Maxwell an automobile that exactly meets their requirements. Not only has it many new points that are self-evident in their practical utility, but its general thoroughness of construction and simplicity of design have won for it a recognition among the "wise ones" never before attained in such a short time.

The Maxwell cars have no pump (thermo-siphon). Their double opposed motor shaft drive is in front under the hood and easily accessible in every part. Bevel Gear Drive, Metal Bodies. Transmission Case and Crank Shaft cast in one piece of Aluminum. "Perfectly simple, simply perfect."

New York City Salesroom, 317, 319 West 59th St.

MAXWELL BRISCOE MOTOR CO.

Tarrytown, NEW YORK.

A NEW SPRING WHEEL FOR AUTOMOBILES.

(*Continued from page 64.*)

There is fitted to either side of the hub of each wheel a six-pointed star-shaped plate. These are connected at each point by a pin. Each pin in turn carries a couple of triangular equalizing pieces between the plates, together with a pair of triangular levers outside. There is a pair of rollers between each equalizing piece, while the rollers on the adjacent triangles are connected by a series of plate springs. The centers of these latter are attached to the star plates by means of bolts, which pass freely through distance pieces between the plates. There are also pin joints connecting each bolt to one pair of corners of the triangular levers, while the other pair of corners are jointed to the center of a pair of segments provided with rollers at the extremities. These rollers bear against the inner side of the rim of the wheel. By this arrangement, when pressure is brought to bear upon any part of the rim of the wheel, such as that on road, the pressure is transmitted from the plate spring immediately opposite the point of application to the whole of the springs around the wheel through the medium of the equalizing pieces. Furthermore, these springs are protected from any oblique strains that may be set up by the agency of the triangular levers.

The inside surface of the rim, on each side of the rollers of the segment pieces, is provided with curved internal projections, so that if there were any motion of the segments, it would cause the latter to approach the center of the wheel. This tendency, however, is resisted by the tension of the plate springs, but yet this will result to a more or less degree, according to the irregularities of the power being transmitted through the wheel, such as arise from the variations in the speed of the motor, or in the resistances afforded by the road. The net result of this principle of design is that a spring drive is obtained, thereby obtaining much smoother running of the engine and the gear.

The foregoing cuts of the apparatus for the driving wheels make it appear rather complicated in construction. Such, however, is not the case, for the device is built up of a series of similar units, each of which, independently, is comparatively simple. It might also be supposed that the wheel is unduly heavy, but such is not the case. By fashioning all parts wherever possible of sheet steel stampings, the minimum of weight consistent with the maximum of strength is obtained. Side thrust or play furthermore is prevented by the series of plates on the obverse side of the wheel. The mechanism is entirely inclosed and protected from the inroads of dust and grit by large disks, which completely inclose the mechanism from the hub or boss to the rim, and also comprise a chamber for the oil to continuously lubricate the various moving parts. The wheel itself is shod with a solid tire of India rubber of shallow sectional thickness and flat on the tread, thereby rendering the wheel less liable to side slip, and lateral movement on greasy roads, than is the case with ordinary pneumatic tires, which, when turning corners at a high speed or upon wet roads, are susceptible to a rolling action and lateral slipping.

From experiments which have been carried out with an automobile fitted with this type of wheel, which is manufactured by the Metropolitan Engineering Association, of London, it has been demonstrated that from the point of resiliency, this mechanical wheel does not differ much from the ordinary pneumatic tire. There is complete absence of noise or rattle, and when run over even the roughest and most uneven roads, it was most comfortable and as resilient almost as the ordinary pneumatic tire. There is no vibration or shock even when traveling over irregularities in the road, as these are absorbed by the springs and levers within the wheel.

RECENTLY PATENTED INVENTIONS.

Of Interest to Farmers.

CHOPPER.—M. S. SOBER, McLoud, Oklahoma Ter. The object of the invention is to provide a new and improved chopper more especially designed for use in cotton-fields, but also useful in corn-fields, rice cultivation, and the like and arranged to permit convenient chopping, cultivating, and thinning of rows in the fields and whipping caterpillars and other insects from the plants without injury to the latter.

CURRENT-MOTOR.—G. SAMUELSON, Sandpoint, Idaho. This invention relates to improvements in motors designed to be placed in a river or other body of water in which there is a current, the object being to provide a current-motor of simple and novel construction that may be utilized for pumping water for irrigating purposes and may be also utilized for operating machinery.

Of General Interest.

TRUNK.—M. B. BEHRMAN, Baltimore, Md. The invention is an improvement in packing-cases—such as trunks, dress-suit cases, shipping cases, delivery-cases such as merchant tailors use to deliver clothing, and similar cases; and the invention has for one of its objects, to provide a construction by which clothing may be held from movement in the case and may be preserved in the position in which it is placed in the case, so that it will not move about and become wrinkled and otherwise deranged.

BUCKLE.—C. L. HASTINGS, Fond du Lac, Wis. Mr. Hastings' invention relates to buckles for use in attaching straps or other flat connecting devices of any kind to each other. One object of his invention is to secure greater holding force in articles of this character than has been attained in previous constructions. The transversely extending cross-bar has a projection which causes a more pronounced pressure upon the strap placed upon it than in the case when this bar is entirely within the surface of the buckle, and thereby prevents slipping of the straps.

Hardware and Tools.

MITER-BOX.—A. VON GUNTEN, St. Charles, Mo. In Mr. Von Gunten's patent the invention has reference to miter-boxes of that particular form in which the saw-frame swings about a vertical axis and also tilts about a horizontal axis to permit the saw to stand in a plane inclined to the vertical.

WRENCH.—F. W. MCNABB, Parry Sound, Canada. This improvement relates to a wrench capable of many uses, but especially adapted for use on pipes and the like, its main objects being to secure a maximum efficiency in devices of this character without increasing the cost or causing any undesirable complication. Other objects are to prevent slipping of the instrument and injury to the pipes or other articles on which it is used and to provide for wide adjustments and the like.

TOOL-HOLDER.—H. LANDIS and G. BOCK, Steglitz, near Berlin, Germany. The invention of Messrs. Langer and Bock has reference to a new tool-holder especially adapted to be used in connection with lathes. An essential feature of the invention consists in the special construction of the locking device, another feature of the invention being the arrangement of the cutting-tool.

Machines and Mechanical Devices.

MATCH-BOX.—E. C. CARRIS, Washington, Iowa. This invention refers to match-boxes that are adapted to supply a single match at a time for removal from the box. The novel feature consists in the provision of deep notches in the lower end of the tray-board, thus forming a resilient central tongue-piece thereon, upon which the matches rest and are individually presented to a pair of fingers for transfer toward the point of arrest for the match; and springs are provided for rocking the shafts and moving the pusher-arms into the cylinder. It is an improvement on a former patent granted to Mr. Carris.

Pertaining to Vehicles.

DRAFT ATTACHMENT FOR VEHICLES.—O. H. KLUGE, Thieman, Minn. This invention relates to an attachment, which may be applied to any kind of a vehicle but is especially adapted to two-horse wagons and the like. The principal object is to provide means for preventing the jar and swinging of the tongue which occurs when one of the wheels meets an obstruction or is raised for any reason. An important feature is the provision of means for permitting the front axle to be swung upon its pivot and also to be swung vertically without bringing most of the strain upon one of the draft animals and also for equalizing the strain upon the animals when one tends to take a larger part of the load.

Designs.

DESIGN FOR A WALL-COVERING.—T. CLEARY, Schuylerville, N. Y. In this ornamental design for wall-coverings, a solid ground color gives a peculiar diversified effect by reason of irregular wiped patches.

NOTE.—Copies of any of these patents will be furnished by MUNN & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of the paper.

$1,200 a Year For Life

SECURED BY SMALL MONTHLY PAYMENTS

The scientific cultivation of crude rubber is the most profitable enterprise of modern times. Because the price of rubber doubled in a decade and the total extinction of the virgin rubber trees of the world became a certainty for the near future, the greatest horticulturists in America and Europe have given their attention to the cultivation on scientific principles of this great necessity of present day civilization. The semi-tropical regions of Mexico were selected for the purpose. There the virgin rubber trees have been ruthlessly destroyed by the improvident natives, and the white men who employed them saw no necessity of preserving the trees for annual tapping, as their number seemed inexhaustible. In that climate the rubber tree can be cultivated just as simply and just as surely as the sugar maple can be grown in Vermont, and can be tapped year after year at an immense profit. The destruction of the virgin tree still goes on in the South American jungles, where the natives are now forced to to seek them at an added outlay of time and money, and where no white man can live to restrain them. The present inadequate supply of crude rubber comes almost entirely from this precarious source. It is inconceivable that the production of one of the great necessities of mankind can longer remian in such ignorant hands.

There is nothing speculative about Crude Rubber. It can be sold every day in the year, in every market in the world, and at a stable price that has been steadily advancing for many years.

The Mutual Rubber Production Company was one of the first to engage in this new and immensely profitable industry on a large scale. Years ago our managers purchased from the Mexican Government over 6,000 acres of land in the heart of Chiapas, the most tropical and fertile State of Mexico. No similar tract is available to-day for less than five times what we paid for ours. Thus the remarkable opportunity is now open to you to secure an interest upon the most favorable terms, in an enterprise that is destined to revolutionize the production of one of the world's greatest staples. No industry ever underwent so radical a development as that in which we are now engaged without making immensely wealthy all those who were interested in the change.

This splendid domain is now fast becoming a great commercial rubber orchard, conducted upon the most scientific principles of modern forestry and under Anglo-Saxon supervision. There are 6,000 shares, each share representing an undivided interest equivalent to an acre of land, planted to rubber trees and brought into bearing, and the price of these shares is $288 each. No large cash-down payment is required to secure them, however, as the shares are paid for in small monthly installments just as the work of development progresses. Thus the man or woman who wishes to secure a safe and certain income for future years, and who is able to save now a few dollars each month, is on the same footing in rubber cultivation as the mightiest capitalist, for wealth alone cannot force the soil.

For example, suppose you buy five shares (equivalent to five acres). You pay $20 a month for twelve months, then $15 a month for twelve more months, then $10 a month for a limited period until you have paid the full price for your five shares, $1,440—or $288 per share.

But meantime your dividends will have amounted to $1,050, or $210 per share. Hence the actual net cost of your five shares, or acres, is $390, or $78 each. We secure these early dividends by planting 600 trees to each acre, and then "tap to death" 400 of them before maturity, getting every ounce of "rubber milk" from them. The dividends secured from the sale of this rubber are sufficient to pay your total money nearly all back before maturity, and then there will be left standing upon each acre 200 trees; and this is the normal number for the permanent yield. These 200 trees will each give at least two pounds of crude rubber per year for more years than you can possibly live. This rubber at 60 cents per pound net profit means a total profit of $240 a year on each acre, or $1,200 a year on your five acres. These figures are not "paper estimates" and they are not ours. They are vouched for by the most reliable sources of information in the world, the Government reports of the United States and Great Britain. Of course if you buy 10 shares your income would be $2,400 a year; or 25 shares will yield you $6,000 annually.

Five Acres, or Shares, in our Rubber Orchard planted to 1,000 Rubber Trees will at maturity yield you a sure and certain income of $100 a month for fifty or more years, and your dividends will average 25 per cent. during the period of small monthly payments.

Every possible safeguard surrounds this investment. The State Street Trust Company of Boston holds the title to our property in Mexico as trustee. We agree to deposit with them the money paid in for shares, and we file with them sworn statements as to the development of the property. This company also acts as registrar of our stock. You are fully protected from loss in case of death or in case of lapse of payments, and we grant you a suspension of payments for 90 days any time you may wish. Furthermore, we agree to loan you money on your shares.

We can prove to you that five shares in this safe and permanent investment, paid for in small monthly installments, will not only bring you **an average return of 25 per cent. on your money during the period of payment,** but will then bring you **$100 a month for more than a life time.** Send us at once $20 as the first monthly payment to secure five shares, $40 for ten shares, $100 for twenty-five shares—$4 per share for as many shares as you wish to secure. Our literature explains our plan fully and concisely and proves every statement. It will be sent to you immediately on request.

Mutual Rubber Production Co.
88 Milk Street, Boston, Mass.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9524) N. L. asks: What causes the sparks between the trolley wire and trolley of an electric car in motion, also the sparks which occur sometimes between the wheels and rails? A. A spark occurs whenever there is an air gap between the trolley wire and the trolley, or between the wheel and the rail. A little gravel on the rail will produce the latter as the wheel strikes it, and a jarring will cause the trolley to leave the wire. 2. Please give the colors in succession that show upon steel in tempering, from the lowest to the highest temper. A. The colors upon steel vary from deep blue up to a high straw color. The blues indicate low, and the straw colors indicate a high temper. The tempering is an individual matter which cannot be taught by a book. 3. Is the United States superior to all other countries in mechanics? If not, what country ranks first, as a whole? A. We think that mechanics in the United States are among the most skillful of any in the world. 4. Do either the inside or outside wheels of a railway car slip in going around a curve? If not, how is this difficulty overcome? A. Both the inside and the outside wheels may slip in going around a curve. 5. In your estimation, in what field are the opportunities better—mechanical or electrical engineering? A. Both mechanical and electrical engineering are good fields for any young man. Each one should follow his preferences. Every one who would enter either profession nowadays should be highly educated. Both mechanical and electrical engineers pursue very nearly the same studies at first, and toward the last of the course take different work. An electrical engineer may soon learn mechanical engineering, and *vice versa*. 6. Is it a fact that 99 per cent of the energy in a ton of coal is lost in transforming that energy into incandescent electric lights, that is to say, is only one per cent of the energy utilized in electric lighting when coal is used as the source of energy? A. It is not true that 99 per cent of the energy of the coal is lost in transforming it into incandescent electrical light. In small steam plants 85 per cent may be lost, and in the large powers, where 1½ pounds of coal produce one horse-power, the loss drops to near 80 per cent of the coal value.

(9525) W. A. G. asks: 1. Kindly show a circuit of three or more gas jets as wired for electric gas lighting. A. To light three gas jets with one coil, and at the same time run the circuit of the secondary coil through each gas burner, connect to the wires of the igniter on the jet, and carry the circuit back to the coil again. This will make a complete circuit from one pole of the secondary around to the other pole. Connect the battery to the primary of the coil, and the switch. This makes another circuit complete. On closing the switch, a series of sparks will be thrown across the gaps at the burners, if the work has been properly done. 2. How should a Ruhmkorff induction coil be connected to the circuit—the primary or secondary being used, or both? A. The battery and switch are in the primary circuit of the coil. The igniters in the secondary circuit. 3. Is there any danger in the wiring, except where it is near the gas pipes? A. There is no danger except where a spark is produced. 4. Are there any liabilities from fire due to the high current? A. There should be no fire set by a battery current. 5. Do the batteries have to be switched in, or is it not necessary? A. The battery is brought into action by closing the switch. At other times it is not in action.

(9526) D. M. asks: To decide a dispute, will you kindly answer which is correct, A or B? A holds that the electric current which runs a trolley car passes through the motor, thence by the wheels to the rails and is then diffused, and that it does not have to go back to the power house by either the rails or the earth. B holds that it goes back to the power house by the rails or the earth, thereby making a complete circuit. A. The theory accepted at present is that the electric current, after passing from the overhead trolley through the motor and the wheels to the rails, is by the bonds of the rails and the rails themselves conveyed back to the dynamo, which is connected by a metallic circuit to the rails for that purpose. There is some

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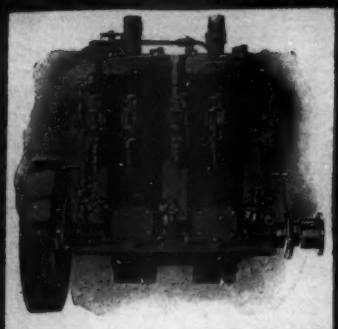

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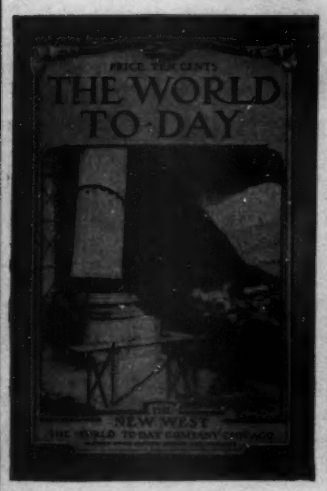

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S. A. 1-28

leakage to the earth, but this stray current ultimately finds its way to the dynamo with the rest. When an underground trolley is used, there is no return by the rails. Two conductors are placed in the conduits, and a double trolley is used. B's view is the accepted one. The suggestion has recently been made that the current is dissipated to the earth, and does not go back to the dynamo, the earth serving as a return in the same manner as in the telegraph, but this has received little attention. The electrolysis of pipes between the rails and the dynamo is against this view.

(9527) E. H. L. asks: 1. Who was the first man to run an electric motor from a dynamo? A. The discovery of the fact that a dynamo would by its current drive another similar machine as a motor is ascribed to Gramme, the inventor of the Gramme ring armature. It is said to have been an accidental discovery. Mr. Tesla invented the rotary magnetic field, by means of which the rotation of the polarity of the magnet poles drags after them the armature in the alternating current system. It was a most valuable discovery. 2. Having a line of shafting on a ground floor used to run agitators, which is the most economical—to run direct with belt from an engine, or to use motors and a dynamo? A. The most recent practice is to run each machine by its own motor, instead of driving from a line of shafting, belting to the separate machines. Its economy is due to the saving of the power required to drive a line of shafting, and the stopping of the power by shutting off the current from the motor the instant the work is done. There is little or no waste of power by this method of driving.

NEW BOOKS, ETC.

STEAM BOILERS. Their Theory and Design. By H. De B. Parsons, B.S., M.E. New York: Longmans, Green & Co., 1903. 8vo.; pp. 375; illustrated. Price, $4.

Students in this branch of practical science will here find, brought together in one volume, much information indispensable to the designing of steam boilers. The author makes no claim of originality, save in the effort to cover those perplexing points constantly confronting the student in practical work. Mr. Parsons's position in the engineering world should be sufficient guarantee of the value of the book.

MODEL STEAM TURBINES. How to Design and Build Them. By H. H. Harrison. London: Percival Marshall & Co., N. D.; 16mo.; pp. 85. Price, 20 cents.

A small experimental turbine is a departure for the model maker, and offers him an admirable scope for his powers. The present volume is thoroughly practical, and will prove of very timely interest.

TYPES AND DETAILS OF BRIDGE CONSTRUCTION. By Frank W. Skinner. New York: McGraw Publishing Company, 1904. 8vo.; pp. 289. Price, $3.

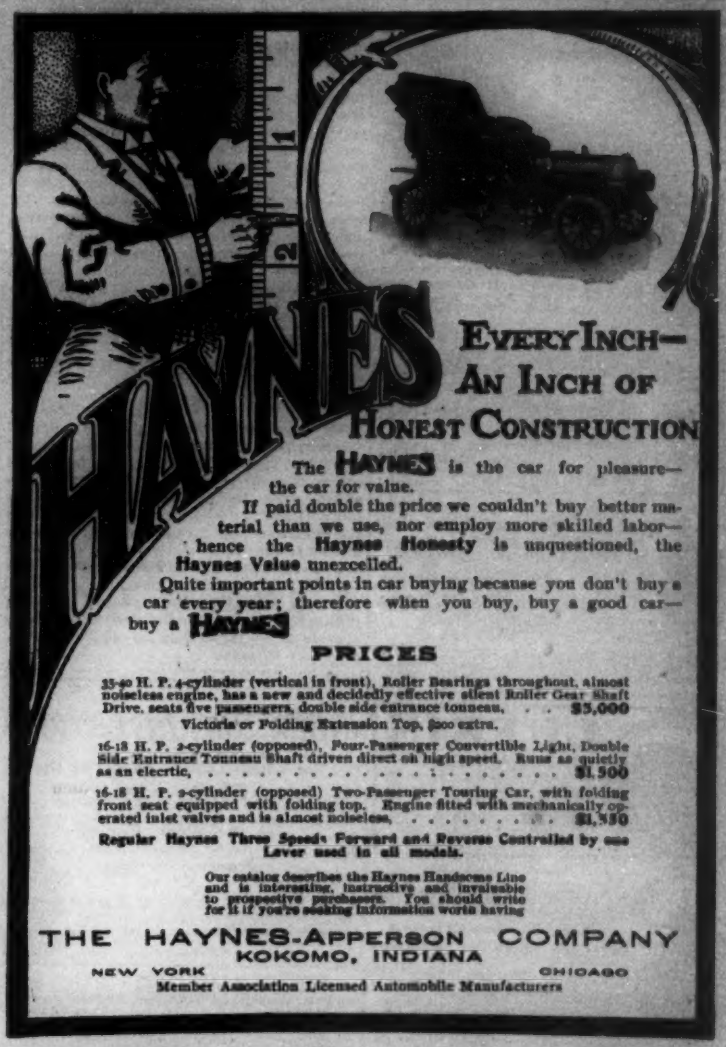
This book forms an epitome of modern American bridge construction. All types of arched bridges are thoroughly illustrated and described, the essential features of construction being clearly brought out in every case. Not only American, but also the best characteristic types of foreign bridges are described. Besides plans and specifications of the bridges as a whole and their details of construction, the book contains numerous half-tone illustrations, showing the completed bridges and the methods used in their construction.

THE ANATOMY OF THE AUTOMOBILE. By A. L. Dyke. St. Louis: A. L. Dyke Automobile Supply Company, 1904. 8vo.; pp. 727; numerous illustrations. Price, $2.50.

This book gives instructions for the care and maintenance of most of the leading American automobiles and a number of foreign cars as well. In most instances detailed descriptions of the automobiles, illustrated by lettered and numbered diagrams, give the reader a good insight into their construction; while this knowledge is supplemented by useful hints concerning the care and operation of the machine. In the case of the foreign cars, the descriptions published have been taken largely from the Automobile Review and the SCIENTIFIC AMERICAN SUPPLEMENT. Besides the description of automobiles, several articles on storage batteries, automobile construction, and the like, add to the value of the book. Its up-to-date character will be realized from the fact that a considerable number of the airships and kites which competed at the St. Louis Exposition are illustrated in the last chapter of the book. On the whole, this book is one of the most complete instruction books that have thus far been published.

BIRDS ON LAND AND SEA. A Record of a Year's Work with Field Glass and Camera. By John Maclair Boraston. Illustrated by photographs taken direct from nature by the author. New York: John Lane, the Bodley Head, 1905. 12mo.; pp. 282. Price, $2.

Mr. Boraston's book, besides giving evidence of careful observation on his part, has the



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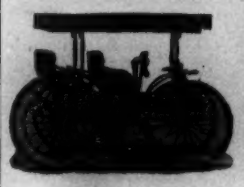

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merit of being written in a delightfully personal vein that lends not a little interest to a subject that could have been only too easily treated with dryness. He has confined his work to a district of comparatively small radius—to Stretford on the River Mersey. For miles around, this low country, with its grassing fields and land under cultivation, offers rare opportunities for studying bird life. Mr. Boraston has made admirable use of these opportunities. He has succeeded in correcting many a popular error, such as the idea that some birds hibernate, and the curious notion, which Dr. Johnson himself accepts, that "swallows conglobulate together by flying around and around and then all in a heap, throw themselves under the water and lie in the bed of the river," there to remain all winter. Mr. Boraston has written his book, not chapter by chapter, but month by month. Most attractive features of the book are a series of excellent photographs of birds in characteristic poses.

We have received from the Derry-Collard Company, 256 Broadway, New York, a splendid engraving showing in detail, both inside and out, a modern battleship, with all the parts named, numbered, and indexed. Although the idea in itself is not new, we must confess that the thoroughness and clearness with which the artist has illustrated the wonderful complexity of a modern fighting ship, has never before been equaled in a picture of this kind. The full engraving shows about 500 parts. The sheet upon which the picture and descriptive matter appears is 44 inches long by 28 inches high, and costs 50 cents.

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AND EACH BEARING THAT DATE

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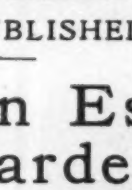

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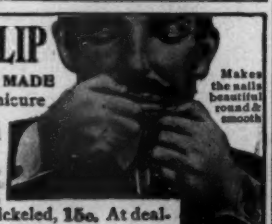

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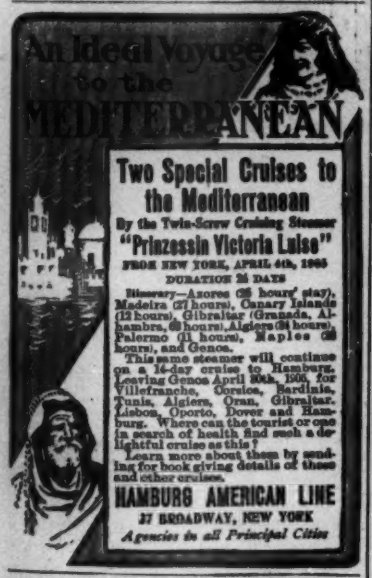

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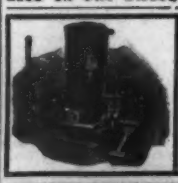

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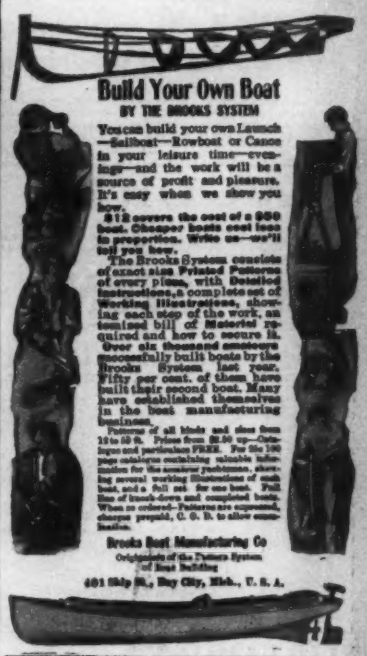

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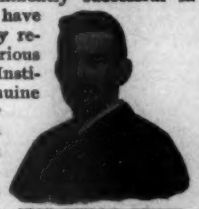

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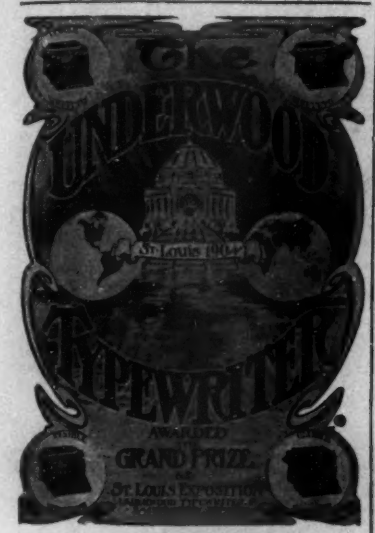

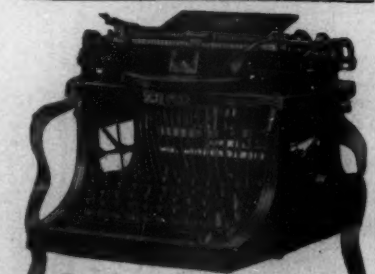

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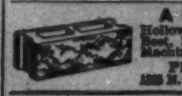

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